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National Aeronautics and Space Administration

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VOLUME 2 NUMBER 18

Scientific and Technical Aerospace Reports

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of the National Aeronautics and Space Administration

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01 GENERAL

Includes administration and management; space law and related legal matters; legislative hearings and documents; and symposia or conferences of a broad or general nature.

N64-25872 Lockheed-California Co., Burbank
DEVELOPMENT PLAN AND COST ESTIMATE ADDENDUM TO A STUDY OF AN ORBITAL MAINTENANCE AND MATERIAL TRANSFER SHUTTLE Technical Documentary Report, Feb.–Oct. 1963
Ray Goodall et al Wright-Patterson AFB, Ohio, Res. and Technol. Div., Mar. 1964 14 p
(Contract AF 33(657)-10290)
(RTD-TDR-63-4057, Addend.; AD-438028)

The basic report presents a preliminary design of a one-man shuttle vehicle used to transport personnel and material between large space stations and to perform in-space maintenance operations. This addendum presents a development plan and a cost estimate for producing two shuttles. The development plan shows that the first operational flight could take place 28 months from go-ahead. A total cost of $15,000,000 is estimated. No new test facilities are required for the development of the shuttle. Author

N64-25885 Illinois U., Urbana Coordinated Science Lab.
PROGRESS REPORT FOR DEC., 1963, JAN., FEB., 1964
[1964] 92 p refs
(Contract DA-36-039-AMC-02208(E))
(AD-438840)

A system, including ground radio-transmitting and rocket-borne receiving equipment, for the measurement of differential absorption and Faraday rotation, is described. Operating statistics for the CSX 1 and CDC 1604 computers are reported. New programs for on-line control of bubble-chamber data processing and the development of a time-sharing system for the IBM 7094 are described. In circuits and communications, research is reported in time-continuous information channels, nonlinear oscillations, synthesis of distributed networks, matching of nonlinear networks, driving-point characterization for time-varying networks, and stability factors for interconnected two-ports. A major effort has been concentrated on the reprogramming of PLATO II material for the PLATO III equipment. A new study of the number of hits/bin and of the accuracy of calculation of the collision integral has led to a significant reduction of the bias of the Monte Carlo method. Phenomena associated with stainless-steel electrodes, the rectangular shape of current pulses in the prebreakdown current, and with the microscopic projections on electrode surfaces are reported. Experience with new equipment and with tin oxide films is reported. I.v.L.

N64-25997 System Development Corp., Santa Monica, Calif.
SCHEDULING IN A MULTIPLE SATELLITE ENVIRONMENT
Robert A. Totschek 6 Mar. 1964 44 p refs
(SP-1466; AD-440045)

The guiding principle of operation in a multiple satellite environment is that each satellite vehicle time-shares component equipments of the Satellite Control Facility (SCF) in accordance with its requirements and its priority among the set of active vehicles. This paper discusses the techniques used for applying this principle by the computer program for multiple satellite scheduling operations, called SCHOPS. Using a dynamic priority logic, SCHOPS resolves these conflicts and produces coordinated schedules of activities for the SCF. Scheduled activities include the following: (1) determination of the times at which each satellite is to be serviced by specific tracking stations; (2) assignment of computer time at the control center for running associated support programs; (3) allocation of communication lines between the control center and remote tracking stations; and (4) scheduling of equipment maintenance at the SCF. Author

N64-26037 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
MAGMA-DEVELOPMENT OF ENERGY. SCIENCE ON THE THRESHOLD OF FANTASY
N. N. Semyonov 2 Apr. 1964 6 p Transl. into ENGLISH from Sauremena Tehnika (Czechoslovakia), no. 15, 19 Aug. 1963 p 288–289
(FTD-TT-63-1088/1; AD-600810)

Soviet scientists are concerned with two fundamental problems—the theory of elementary particles in physics and the structure of highly organized biological matter. This is a general nontechnical review of anticipated progress in energy development as it relates to human beings. G.D.B.

N64-26126 Advisory Group for Aeronautical Research and Development, Paris (France)
THE HIGH TEMPERATURE ASPECTS OF HYPERSONIC FLOW
Wilbur C. Nelson ed. (Michigan U.) N.Y., Macmillan, 1964 786 p refs Proceedings of the AGARD-NATO Specialists' Meeting held at the Tech. Centre for Exptl. Aerodynamics, Rhode-Saint-Genèse, Belgium, 3–6 Apr. 1962
(AGARDograph-68)

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36. AN ASSESSMENT OF OUR PRESENT STATUS AND FUTURE REQUIREMENTS FOR HIGH TEMPERATURE HYPERSONIC FACILITIES R. N. Cox et al p 745–788 refs

N64-26166 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

OVERALL DIMENSIONS AND CONDITIONS FOR TRANSPORTING DIMENSIONLESS LOADS

V. S. Bezruchko, Z. I. Goroza et al 17 Jun. 1964 20 p Transl. into ENGLISH from Spravochnik Dor. Mastera (Moscow), 1963 p 44–60

(FTD-TT-64-621/1+2)

A new overall dimension for *C* class construction, adopted by the Soviets in 1960 according to GOST 9238-59, is discussed. These overall size standards are used in the construction of new railroads, the laying of tracks, and for the moderating of profiles and the electrification of railroads, as well as for other jobs pertaining to the reconstruction of railroads, equipment, and installations. I.v.L.

N64-26421* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

CLARITY IN TECHNICAL REPORTING

S. Katzoff Washington, NASA, 1964 30 p

(NASA-SP-7010) GPO: $0.15

This booklet offers commonsense suggestions for improving written technical reports. In particular, it discusses basic attitudes, some elements of composition, the organization and contents of the report, and the editorial review. Since technical information is transmitted not only in written reports but also in talks and lectures, a section is devoted to the technical talk—the orally delivered technical report. In both written and oral reports, stress is placed on striving for clarity. I.v.L.

N64-26474 European Atomic Energy Community, Brussels (Belgium)

REGIONAL COOPERATION IN THE FIELD OF SCIENTIFIC AND TECHNICAL INFORMATION WITHIN THE EUROPEAN COMMUNITY

R. Bree ID, Jan. 1964 22 p refs Presented at the 29th Conf. of the Intern. Federation for Doc., Stockholm, 5 Oct. 1963 (EUR-494.e) Available from the Belgian Am. Bank and Trust Co., N.Y., Account No. 121.86: 40 Belg. Fr.

The first results of Euratom's action in the field of information and documentation within the Community are outlined with an emphasis on the interdependence of the European documentation and information centers, this interdependence being indispensible because of the constant increase in volume of data. The first practical consequences of a carefully planned division of tasks between Euratom and these national centers are described, as well as the multifaceted program of Euratom's information and documentation center (CID). Author

N64-26494 System Development Corp., Santa Monica, Calif.

SAGE ENVIRONMENTAL DATA AND EQUIPMENT ASSIGNMENTS FOR CHICAGO ADS CHADS Recon June 1964

F. R. Holland 15 Apr. 1964 26 p

(Contract AF 19(628)-1648)

(TM(ADC)820/302/03; Supersedes SDC-TM (ADC)820/302/02; AD-440013)

This volume contains the official SAGE unique-to-site environmental data and equipment assignments to be used in adapting the Model 9 computer programs, and in Simplex data distribution unit terminal assignments for this air defense sector. Author

N64-26561* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics

[RESEARCH ACTIVITIES IN RADIO PHYSICS, PLASMA DYNAMICS, AND COMMUNICATION SCIENCES AND ENGINEERING] Quarterly Progress Report No. 73

H. J. Zimmermann and G. G. Harvey 15 Apr. 1964 254 p refs (Grants NsG-496; NSF G-16526; Contracts AF 33(615)-1083; DA-36-039)AMC-03200(E); AT(30-1)-1842)

(QPR-73; AD-439345)

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19. COGNITIVE INFORMATION PROCESSING p 231–238 refs
20. ARTIFICIAL INTELLIGENCE p 239–247 ref

N64-26749* National Aeronautics and Space Administration, Washington, D.C.

TECHNICAL ILLUSTRATING—PREPARING CONTRACTOR REPORTS FOR NASA

Jul. 1964 27 p

(NASA-SP-7008) GPO: $0.15

A guideline is presented to insure the proper selection of size, shape, and style of illustrations for use in printed technical publications for NASA. The following areas are covered in detail: (1) materials; (2) graphs; (3) line drawings; (4) perspective drawings; (5) typography and lettering; (6) photographs; (7) layouts; and (8) figuring reductions. J.L.D.

N64-26753* National Aeronautics and Space Administration, Washington, D.C.

BIBLIOGRAPHIES ON AEROSPACE SCIENCE: A CONTINUING BIBLIOGRAPHY, JANUARY 1962–MAY 1964

[1964] 75 p refs

(NASA-SP-7006)

All references in SP-7006 are bibliographies that have been announced in either "Technical Publications Announcements" (TPA-Vol. 2, 1962), or its successor, "Scientific and Technical Aerospace Reports" (STAR-Vol. 1, 1963) and Vol. 2 (Jan.–May, 1964), or in "International Aerospace Abstracts" (IAA-Vol. 3, 1963) and Vol. 4 (Jan.–May, 1964). They were

introduced into the NASA information system during the period January 1962 to May 1964. Each entry in the bibliography consists of a citation and, when available, an abstract. A subject index is included. I.v.L.

N64-26888 Lincoln Lab., Mass. Inst. of Tech., Lexington
DATA SYSTEMS Quarterly Progress Report, V. 2, 1 Feb.–30 Apr. 1964
F. C. Frick et al 15 May 1964 21 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-57; AD-600838)

The current status of the following areas in presented: (1) digital computers—computer systems, circuit development, and magnetic-film engineering; (2) computer components—electron transport, magnetic films, and advanced circuits; (3) psychology—an automatic procedure executor and human information processes; and (4) control research—hybrid computation and data file, storage, retrieval, and editing. I.v.L.

N64-26955* National Aeronautics and Space Administration, Washington, D.C.
GUIDE TO THE SUBJECT INDEXES FOR SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS, APRIL 1964, ISSUE NO. 1
[1964] 272 p
(NASA-SP-7016) OTS: $2.75

The Guide to the Subject Indexes for "Scientific and Technical Aerospace Reports" (STAR) contains a listing of subject terms (basic index points and cross-references) that have been used in the indexes to STAR and "International Aerospace Abstracts" (IAA). It is published to enable persons searching the literature to use the subject indexes efficiently and rapidly, and supersedes the "Guide to the Subject Index for Technical Publications Announcements," published December 31, 1962. The subject terms in this publication are arranged alphabetically. For added usefulness, those terms that have been used as basic index points are usually accompanied by a "see also" (SA) or a "confer" (CF) cross-reference. Subject terms that cannot be used as basic index points (within the limits of the vocabulary) will always be accompanied by a "see" (S) notation to appropriate terms that are adaptable to indexing. I.v.L.

02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW

Includes aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc. *For related information see*: 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 11 Fluid Mechanics.

N64-25870 Aeronautical Research Council (Gt. Brit.) Engineering Lab.
THREE-DIMENSIONAL DISTURBANCES IN A TWO-DIMENSIONAL INCOMPRESSIBLE TURBULENT BOUNDARY LAYER
H. Fernholz London, HMSO, 1964 18 p refs
(ARC-R&M-3368) HMSO: 6s 6d

Measurements in turbulent boundary layers have shown large transverse variations of skin friction. It appears that these are associated with three-dimensional disturbances originating in the transition region. The disturbances cannot be explained by irregularities in the damping screens and cannot be eliminated by fixing transition. Author

N64-25912* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
AERODYNAMIC CHARACTERISTICS OF SEVERAL PROPOSED VERSIONS OF THE SATURN V LAUNCH VEHICLE AT MACH NUMBERS 1.57 TO 4.65
Dennis E. Fuller and Roger H. Fournier Washington, NASA, Jul. 1964 34 p
(NASA-TN-D-2352) OTS: $1.00

An investigation was conducted in a wind tunnel to determine the aerodynamic characteristics of several proposed Saturn V launch configurations. The investigation included tests to determine the aerodynamic characteristics of several proposed upper-stage spacecraft systems in the presence of the lower two stages of the Saturn launch vehicle. The tests were conducted at Mach 1.57 to 4.65, at angles-of-attack from about $-9°$ to $18°$, and at a Reynolds number per foot of 2.5×10^6 and 2.3×10^6. The results indicate that the basic third-stage spacecraft system has the lowest normal-force-curve slope of the four systems investigated and thus may have lower structural moments when combined with the lower stages. Nozzle shrouds as well as fins on the first stage have a significant stabilizing effec* Author

N64-25919 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
A REVIEW OF LATERAL JET-SUPERSONIC STREAM INTERACTIONS WITH REFERENCE TO REACTION CONTROL APPLICATIONS
H. Watman and R. C. Meyer Apr. 1963 38 p refs
(ADR-01-07-63.2)

A summary of available data indicates that lateral jet-free stream interaction is most significant at low jet-to-free-stream pressure ratios. Plate and aft-body mounted jets exhibit a large favorable augmentation of nozzle-alone thrust while body mounted nose-jets are affected adversely. The augmentation obtained with aft-body jets is dependent to some extent upon nozzle diameter and type but primarily upon location forward of the body base. Control forces comparable to those on plates are obtained with aft-jet fin–body combinations. Author

N64-26002* National Aeronautics and Space Administration, Washington, D.C.
DIFFUSER PERFORMANCE OF A MACH 6 OPEN-JET TUNNEL AND MODEL-BLOCKAGE EFFECTS AT STAGNATION TEMPERATURES TO 3,600°F
Raymond E. Midden and Bennie W. Cocke, Jr. Jul. 1964 25 p refs
(NASA-TN-D-2384) OTS: $0.75

A diffuser evaluation program was conducted to develop an effective fixed-area diffuser for a Mach 6 open-jet wind tunnel. In this program several diffuser parameters were varied and evaluated in terms of empty-jet starting efficiency and running efficiency with blunt models and support systems inserted in the airstream. Permissible model blockage for tunnel operation was defined for several variations of the diffuser parameters. Test results show that good recoveries can be obtained with the fixed-area diffuser, and that blunt models (hemispheres) with up to 18% blockage can be operated in a tunnel with a properly designed diffuser. Investigation also shows that operation with blunt models requires the use of second-minimum area ratios appreciably larger than the optimum empty-jet values. Furthermore, better efficiencies were obtained with short free-jet lengths and second-minimum sections over 4 diam in length. Author

N64-26047 Canadian Armament Research and Development Establishment, Valcartier

STABILITY AND RESONANCE OF SYMMETRIC MISSILES

Hugh Conn (Computing Devices of Canada, Ltd.) Feb. 1964 16 p refs

(ARPA Order 133)

(CARDE-TN-1599)

Exact expressions relating the aerodynamic coefficients to the frequency and damping characteristics of a free-flight symmetric missile are given. These relationships are used to obtain stability and resonance criteria. This report does not contain new information but presents equations describing the behavior of symmetric missiles at small angles-of-attack that are not easily available from other sources. Author

N64-26129 Imperial Coll. of Science and Tech., London (Gt. Brit.)

THE EFFECTS OF VIBRATIONAL RELAXATION ON HYPERSONIC NOZZLE FLOWS

J. L. Stollery, J. E. Smith, and C. Park *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 49–66 refs (See N64-26126 18-01)

This paper is presented in two parts. In Part I, vibrational relaxational effects are examined for hypersonic nozzle airflows. A simple method of estimating the distribution of vibrational temperature along a nozzle is described, and higher order approximations are discussed. In Part II, the problem of nonequilibrium flow of a vibrating gas through a hypersonic hyperbolic axisymmetric nozzle is solved, using a computer. The vibrational temperatures obtained are compared with those calculated, using the simple method given in Part I. The changes of pressure, density, and velocity due to vibrational relaxation are also given, and a simple method of estimating these changes is described. N.E.A.

N64-26132 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.

A SIMILITUDE FOR NON-EQUILIBRIUM PHENOMENA IN HYPERSONIC FLIGHT

N. E. Gibson and P. V. Marrone *In* AGARD The High Temp. Aspects of Hypersonic Flows 1964 p 105–131 refs (See N64-26126 18-01)

(Contracts AF 40(601)-928; DA-30-069-ORD-3443; Proj. Defender)

This paper gives a summary of previous work on nonequilibrium blunt-body flows. A correspondence has been established between the chemical relaxation zone behind a normal shock and that along a streamline in blunt-body flow. In both cases, Newtonian theory predicts that the gas enthalpy will remain nearly constant. This prediction is well verified by exact solutions, and a mapping of normal-shock solutions may be carried out. The mapping is generally accurate and provides a simple approach to nonequilibrium blunt-body flows. Shock mapping applies for binary kinetics and nonrestriction along the stagnation streamline. Using shock mapping, chemical freezing and binary scaling of blunt-body flows may be studied. The results obtained for nonequilibrium airflows with coupled chemistry are discussed. N.E.A.

N64-26133 Polytechnic Inst. of Brooklyn, N.Y.

THEORETICAL STUDIES OF INVISCID HYPERSONIC FLOWS WITH CHEMICAL REACTIONS

Roberto Vaglio-Laurin *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 133–148 refs (See N64-26126 18-01)

(Contract AF 49(638)-217)

Continuum flows about blunt-nosed slender bodies representative of missiles and satellites are considered with emphasis on observables. Solutions applicable near the nose and very far downstream are presented and evaluated by comparison with a large number of results obtained by numerical experiments. Effects of chemical reactions on fluidmechanical aspects of the problem, in particular on similitude, are discussed. Author

N64-26134 General Applied Science Labs., Inc., Westbury, N.Y.

HYPERSONIC FLOW FIELD CALCULATIONS—THREE DIMENSIONAL AND REAL GAS FLOWS

Gino Moretti and Robert W. Byrne *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 149–162 refs (See N64-26126 18-01)

(Contract AF 33(616)-7721)

This paper describes briefly the numerical methods used to provide the hypersonic-vehicle designer with engineering information about the local environments surrounding these vehicles. The procedures described illustrate the utility of numerical calculations for the description of hypersonic flow fields. The method used for calculation of the hypersonic flow fields about axisymmetric bodies at zero angle-of-attack is discussed first. Secondly, the method used to calculate three-dimensional flow fields are discussed in detail. N.E.A.

N64-26135* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

RECENT INVESTIGATIONS OF THE AERODYNAMIC CHARACTERISTICS OF GENERAL AND SPECIFIC LIFTING AND NONLIFTING CONFIGURATIONS AT MACH 24 IN HELIUM, INCLUDING AIR-HELIUM SIMULATION STUDIES

Arthur Henderson, Jr. *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 163–190 refs (See N64-26126 18-01)

Recent hypersonic helium results are presented in Mach 11 to 24 on various general and specific configurations. These include studies of induced pressures on cylindrical rods behind various nose shapes, variation of the longitudinal aerodynamic characteristics of a series of low fineness ratio bodies with systematic changes in geometry, and an experimental air–helium simulation investigation. The induced pressure study showed viscous effects to be significant in the region near the shoulder where the blast-wave theory is known to be inapplicable and far downstream where, at lower Mach number, the blast-wave theory is adequate. The low fineness-ratio-body investigation presents a wide variety of shapes and their corresponding aerodynamic characteristics. The range of configurations examined includes shapes that may closely satisfy several plausible design criteria for planetary entry probes. The air–helium simulation investigation, for which initial results are presented, attempts to shed some light on the extent to which relatively simple air–helium correlations can be applied and whether helium results, as obtained, in sufficient quantitative agreement with ideal air results are valuable for engineering design purposes and configuration development. The investigation consisted of force and moment studies on various general and specific aerodynamic shapes; the general shapes were tested at Mach 9.6 in air and 10.9 in helium; the specific configurations were tested at a Mach 24 in helium and compared with data on the same configurations from Hotshot tunnels in Mach 15 to 22 range. Author

N64-26144 France Office National d'Etudes et de Recherches Aeronautiques

PROBLEMS OF INTERPRETING THE RESULTS OF MEASUREMENTS IN AN ARC WIND TUNNEL [PROBLEMES D'INTERPRETATION DES RESULTATS DE MESURES DANS UNE SOUFFLERIE A ARC]

J. P. Chevallier and F. Bouniol *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 357–370 refs in FRENCH (See N64-26126 18-01)

The operation of the O.N.E.R.A. ARC 1 wind tunnel has demonstrated the importance of certain problems, both resolved and unresolved, that gave rise to the following observations: (1) Direct measurements of flow temperature have pointed out the deficiency in homogeneity of arc heating. (2) It is convenient to introduce, in a real-gas calculation, corrective factors that permit the utilization of perfect-gas tables, where $\gamma = 1.40$. A simple method is proposed for the calculation of nozzles under varied flow-generating conditions. (3) The importance of the quality of the nozzle's attained sonic region is emphasized; a simple system is utilized that permits the elimination of unsuitable diaphragms. (4) Measurement errors, temperature heterogeneities, and gas contamination are evaluated. It appears absolutely necessary to measure simultaneously the stagnation pressure and temperature in front of the model. Trans. by I.v.L.

N64-26145 General Motors Corp., Santa Barbara, Calif. Defense Research Labs.

HIGH VELOCITY GUNS FOR FREE-FLIGHT RANGES

A. C. Charters and John S. Curtis *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 371–404 refs (See N64-26126 18-01)

Free-flight ranges were modified for research in high-velocity flight. Tests can be carried out under the conditions of reentry of missiles and spacecraft. Instruments were devised for recording the optical radiation, the ionization, and other features of reentry flight. Guns were developed that will fire aerodynamic models at the velocities of full-scale flight. A study of gun performance suggests that the highest velocities in firing aerodynamic models will be produced by a gun that accelerates the model with a constant force throughout the firing run. The accelerated-reservoir light-gas (AR-LG) gun appears to fire models with this constant acceleration performance. An analysis of the gun's operation is being carried out, and a systematic series of firings is being carried out to evaluate the gun's performance. Comparison of theory and experiment indicates that in fact the AR-LG gun accelerates projectiles with a nearly constant force. Experience in firing difficult projectiles substantiates this contention. An AR-LG gun fired a saboted glass sphere at a velocity of 26,800 ft/sec and a solid plastic cylinder at a velocity of 32,800 ft/sec. In both of these categories, it is believed that these velocities are the highest reached with guns up to the present time. Author

N64-26148 Avco-Everett Research Lab., Everett, Mass.

ON CHEMICAL EFFECTS AND RADIATION IN HYPERSONIC AERODYNAMICS

Peter H. Rose and J. Derek Teare *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 447–470 refs (See N64-26126 18-01)

This paper represents a review of the state of knowledge, with special emphasis on the work in progress, of the radiative characteristics of nonequilibrium flows and strong normal shocks. This problem couples knowledge of chemical kinetics, radiation physics, and the dynamics of hypersonic flows. Consequently, a short review of chemical kinetics and radiative properties of air is also made. The normal shock front is singled out as the area where the most complex coupling of chemistry and radiation occurs. Fortunately the shock front is easily accessible to laboratory experimentation, and much research has been performed and is in progress. Calculations of nonequilibrium flow chemistry were made and are discussed. The problem of coupling between vibrational relaxation and dissociation processes is discussed. Correlations of radiation with the shock front chemistry depend on some assumptions regarding the electronic temperature. Some of the evidence for relating the electronic temperature to the vibrational temperature and the need for further understanding of the excitation processes are discussed. An empirical method of calculating shock front radiation is given based on use of experimental measurements of rise time of radiation. Finally the shock front calculation technique is discussed in terms of its application to the bow shock problem for blunt bodies. A stream tube method plus the empirical radiation calculation is used to arrive at a first approximation to the nonequilibrium radiation history in the blunt body flow field. Author

N64-26152 Naval Ordnance Lab., White Oak, Md.

EXPERIMENTAL MEASUREMENT OF SHOCK DETACHMENT DISTANCE ON SPHERES FIRED IN AIR AT HYPERVELOCITIES

R. Kenneth Lobb *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 519–527 refs (See N64-26126 18-01)

This paper presents results from some of the recent shock detachment measurements obtained on spheres fired into the air. The investigations yield accurate information concerning the thermodynamic state variables of high-temperature air in equilibrium, as well as a check of the calculated values available in the literature. If the density is sufficiently low, then the shock detachment distance becomes a measure of the lag in the exchange between the energy of the translational motion and the internal modes and chemical reactions. N.E.A.

N64-26161 General Electric Co., Schenectady, N.Y. Research Lab.

LEADING EDGE BLUNTNESS AND SLIP FLOW EFFECTS IN HIGH TEMPERATURE HYPERVELOCITY FLOW OVER A FLAT PLATE

H. T. Nagamatsu, J. A. Weil, and R. E. Sheer, Jr. *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 717–742 refs (See N64-26126 18-01)

An investigation was conducted in a hypersonic shock tunnel to study the effects of leading-edge bluntness on rarefied hypersonic flow over a flat plate. The free stream Mach range was 7.80 to 25.4 with corresponding stagnation temperature of 2,600° and 7,000° R. For these test conditions, the strong interaction parameter, $\chi = M_1^3/\sqrt{Re_x}$, varied from 2.46 to 658. The leading edge Knudsen number varied from 0.011 to 2.14 with a leading edge thickness of 0.035 in. Schlieren photographs at these test conditions indicated the existence of a detached shock wave for a Knudsen number range of 0.011 to 0.076. When the Knudsen number is approximately 0.011 or less, the leading edge can be considered blunt, resulting in an increase in the heat-transfer rates over the case of a sharp flat plate. As the Knudsen number increases, the shock wave is not detached and the strong shock wave and boundary layer are delayed in forming due to slip flow phenomenon at the leading edge. The heat-transfer results for a stagnation temperature of 2,600° R, flow Mach range of 15.9 to 25.4, and Knudsen number of 0.024 to 0.168 indicate that bluntness and slip flow effects are small. In addition, the heat-transfer coefficient agreed reasonably well with the theoretical prediction of Li and Nagamatsu for a noninsulated flat plate. At the higher stagnation temperature of 7,000° R with some real gas effects the

Knudsen number varied from 0.076 to 2.14, with corresponding flow Mach numbers of 7.80 to 18.0. At these conditions the leading-edge slip flow drastically lowered the heat-transfer rates near the leading edge as compared to the theoretical prediction with no slip. Author

N64-26332 Naples U. (Italy) Aeronautical Institute
CHEMICAL RELAXATION FOR CHANNEL FLOWS OF DOUBLY REACTING MIXTURES
L.G. Napolitanol *In* AGARD Supersonic Flow, Chem. Processes and Radiative Transfer 1964 p 157–175 refs (See N64-26326 18-11) Pergamon Press: 9 £

An analysis of the decay of an initial nonequilibrium state of a binary reacting mixture in a constant area channel is presented within the framework of linear irreversible thermodynamics. This is done to determine which of the several thermodynamic, dynamic, and chemical kinetic parameters influence more markedly the decay. Author

N64-26367* Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
EXPERIMENTAL STUDIES OF CHEMICAL NONEQUILIBRIUM IN HYDROGEN NOZZLE FLOWS
A. L. Russo, J. G. Hall, and J. A. Lordi Jun. 1964 56 p refs (Contract NASr-109)
(NASA-CR-58137; CAL-AD-1689-A-4) OTS: $5.60 ph

The effects of finite recombination rates on the flow of highly dissociated hydrogen in an argon bath were studied in supersonic nozzle expansion flows of shock-heated H_2/Ar mixtures. Nozzle-wall static pressure distributions were obtained for expansions from a reservoir temperature of 6,000° K and reservoir pressures of 28, 57, and 112 atm. The measured pressures show a definite departure from the values expected for equilibrium flow, and this is interpreted as due to lag in H-atom recombination during the flow expansion. Recombination rate constants were determined to about a factor of 2.5 by comparing the experimental pressure data with exact numerical calculations. The mean values of these recombination rate constants were in agreeement with corresponding rate constants deduced from shock-wave dissociation results. Author

N64-26417* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
LAMINAR SLIP FLOW HEAT TRANSFER IN A PARALLEL-PLATE CHANNEL OR A ROUND TUBE WITH UNIFORM WALL HEATING
Robert M. Inman Washington, NASA, Aug. 1964 40 p refs (NASA-TN-D-2393) OTS: $1.00

An analysis was made to determine the heat-transfer characteristics for laminar flow of a slightly rarefied gas in a parallel-plate channel or in a circular tube with uniform wall heat flux. Velocity-slip and temperature-jump boundary conditions at the conduit walls are considered. The results obtained apply along the entire length of the conduit. The solution contains a series expansion, and analytical expressions for the eigenvalues and eigenfunctions are presented. The results give the wall temperatures, Nusselt numbers, and thermal entrance lengths for the conduits for various values of the rarefaction parameters. Author

N64-26610* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUPERSONIC LATERAL-DIRECTIONAL STABILITY CHARACTERISTICS OF A 45° SWEPT WING-BODY-TAIL MODEL WITH VARIOUS BODY CROSS-SECTIONAL SHAPES
Dennis E. Fuller and James F. Campbell Washington, NASA, Aug. 1964 45 p refs
(NASA-TN-D-2376) OTS: $1.25

An investigation was made in the Langley 4- by 4-foot supersonic pressure tunnel to determine the lateral, directional, and longitudinal stability characteristics of a 45° swept wing-body-tail model having various body cross-sectional shapes. The cross-sectional shapes tested include a circle, an ellipse, a flat-bottom teardrop, an upright triangle, and an inverted triangle. Tests were performed at angles-of-attack of about −4° to 22°, at angles-of-sideslip from about −4° to 8°, at Mach 1.41 and 2.20, and at a Reynolds number per foot of 3.0×10^6. The results indicate that the directional stability, particularly for high angles-of-attack, was found to be dependent on body cross-sectional shape. A circular fuselage generally indicates the least effects of angle-of-attack on the lateral-directional stability characteristics of any of the body shapes tested. Author

N64-26754 National Aeronautical Lab., Bangalore (India)
EFFECT OF SHOCK BOUNDARY LAYER INTERACTION ON AIRFOIL PRESSURE DISTRIBUTIONS AT TRANSONIC SPEEDS
D. Tirumalesa Apr. 1963 40 p refs
(TN-AE-16-63)

A method of improving prediction of pressure distributions by the inviscid flow theory over two-dimensional airfoils at transonic speeds taking into account shock-wave turbulent boundary-layer interaction is described. This method has been applied to a nonlifting circular arc airfoil of 8% relative thickness. The position of the shock wave, the maximum Mach number, the Mach number distribution, and the drag coefficient were determined. The results are compared with experimental and inviscid theoretical results. The method gives results that are consistent with experimental determinations in various aspects. The method must be improved by considering curvature effects and the separation phenomenon. A suitable combination of Rotta's results for weak and strong shocks in inviscid flow in which the former predominates at low Mach numbers and the latter at high Mach numbers can lead to a further improvement in the results. Author

N64-26770* Consultants and Designers, Inc., Arlington, Va.
CONICAL BODIES OF LEAST RESISTANCE IN A HYPERSONIC GAS FLOW [KONICHESKIYE TELA NAIMEN'SHEGO SOPROTIVLENIYA V GIPERZVUKOVOM POTOKE GAZA]
A. L. Gonor 6 Jul. 1964 9 p ref Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 28, no. 2, 1964 p 383–386 (Contract NAS5-2078)
(NASA-TT-F-8920; ST-AD-10166)

Conical shapes were investigated for minimum drag in a hypersonic flow by formulating a variational problem and solving it by simple approximate formulas. The gravitational problem was solved for thin bodies and for these conical shapes, and its solution allows the construction of an optimum transverse contour of a body with the least drag. D.E.W.

N64-26775* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUPERSONIC AERODYNAMIC CHARACTERISTICS OF A SERIES OF BODIES HAVING VARIATIONS IN FINENESS RATIO AND CROSS-SECTION ELLIPTICITY

Bernard Spencer, Jr., W. Pelham Phillips, and Roger H. Fournier Washington, NASA, Aug. 1964 78 p refs
(NASA-TN-D-2389) OTS: $2.00

An investigation was conducted in the Langley Unitary Plan wind tunnel to determine the effects of cross-sectional ellipticity and fineness ratio on the longitudinal and lateral aerodynamic characteristics of a series of 2/3-power low-wave-drag bodies at Mach 1.50 to 2.86. Reynolds number per foot was held constant at 2.75×10^6 for all Mach numbers. The angle-of-attack range was from approximately −50 to 29° at 0° and 5° of sideslip. Increasing body major-to-minor axis ratio, with the major axis horizontal, resulted in large increases in the lift, drag, and pitching-moment coefficients and lift–drag ratios at positive angles-of-attack and at all test Mach numbers. The successive increases in major-to-minor axis ratio, with the major axis horizontal, resulted in gains in lift-curve slope for bodies of the same fineness ratio when the coefficients were based on the respective body projected planform areas; generally, only slight changes in the minimum-drag characteristics of the bodies were noted. A rearward shift in the body center-of-pressure location is generally indicated when the horizontal-to-vertical axis ratio is increased from 0.50 to 2.00. Little or no effects of increasing Mach number on the center-of-pressure location of a given body were shown. Author

N64-26916 ARO, Inc., Arnold Air Force Station, Tenn.
JET SPREADING CHARACTERISTICS AT PRESSURE ALTITUDES OF 180,000 TO 260,000 FEET
C. C. Prunty Arnold Eng. Develop. Center, Aug. 1964 40 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-95; AD-603341)

An investigation was conducted to determine the effects of certain parameters on the spreading characteristics of a jet discharging from conical underexpanded nozzles into a quiescent atmosphere. Tests were conducted in low-pressure chambers using both nitrogen and carbon dioxide as the nozzle fluid. Flow visualization enabling the expanding jet to be photographed was accomplished by a glow discharge technique. Boundaries are presented for 7.5, 25.3, and 45.7 area ratio nozzles having 15° half-angle conical divergence. The experimental boundaries are presented and compared with contours calculated by the method-of-characteristics. Jet boundaries obtained using nitrogen as the nozzle fluid compare favorably with the theoretical boundaries. The boundaries obtained with carbon dioxide nozzle flow were expanded much more than predicted by the method-of-characteristics because of condensation in the jet. Author

N64-26952 Toledo U., Ohio Research Foundation
AN INVESTIGATION OF CONSTANT AREA SUPERSONIC FLOW DIFFUSION
Andrew A. Fejer, George L. Heath, and Richard T. Driftmyer Wright-Patterson AFB, ARL, May 1964 75 p refs
(Contract AF 33(616)-8271)
(ARL-64-81; AD-603313)

Experiments were conducted to determine the nature of the deceleration of supersonic airstreams in straight passages of constant cross sectional area. The magnitude of the losses associated with the recovery of kinetic energy was established. Schlieren observations were made of the field of flow in the passage and the influence of passage length, and Mach number and effective Reynolds number on maximum obtainable pressure rise were investigated. Author

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES

Includes ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics.

N64-25836 Grumman Aircraft Engineering Corp., Bethpage, N.Y. Aero Technology Group
FORCES AND MOMENTS DUE TO PROPELLANTS OF ARBITRARY CONFIGURATION INCLINED WITH RESPECT TO FREE STREAM
I. Waaland and R. E. Bower 10 Dec. 1963 34 p refs
(ADR-01-03-63.2)

Study of inclined propeller theory revealed an effective solidity parameter that takes into account the blade shape. Use of this effective solidity, given as the product of average blade chord and solidity, led to general expressions for the normal force and pitching moment (or side force and yawing moment) derivatives. These are tabulated along with simple equations of inflow angle, advance ratio, thrust coefficient, and other propeller characteristics. Comparison with another method and experimental data for various blade shapes shows a good order of accuracy. Author

N64-25849 France Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux
MEASUREMENT OF COEFFICIENTS OF SMALL ASPECT-RATIO AILERONS AT TRANSONIC SPEEDS [MESURE DE COEFFICIENTS D'AILERONS DE FAIBLE ALLONGEMENT EN TRANSSONIQUE]
Henri Loiseau May 1964 25 p refs in FRENCH; ENGLISH summary
(ONERA-TN-75)

Experimental results in this field already published concerned transonic measurements on two- and three-dimensional ailerons extending all along the span. More recent measurements have provided experimental results in the case of very small aspect-ratio ailerons (same order of magnitude as in the case of real airplanes) working close to each other and mounted on the same axis of rotation. The direct and the coupling terms between the two ailerons have been obtained. They are compared with those given by a simple method applicable to supersonic speeds. Author

N64-25878 National Aeronautical Lab., Bangalore (India)
EFFECT OF AEROFOIL CURVATURE ON THE SHOCK-BOUNDARY LAYER INTERACTION AND AEROFOIL PRESSURE DISTRIBUTIONS AT TRANSONIC SPEEDS
D. Tirumalesa Nov. 1963 13 p refs
(NAL-TN-AE-20-63)

The effect of aerofoil curvature on the shock–boundary-layer interaction and aerofoil pressure distributions at transonic speeds when there is no shock-induced separation was studied for a circular arc aerofoil of 8% relative thickness. In this case, the upstream extent of interaction decreases with increase in shock upstream Mach number or more rearward shock positions. Due to this decrease in the upstream extent, the upstream Mach number is not much changed for an aerofoil thickness ratio of 8%. However, it appears that the effect will be of significance in the case of thinner aerofoils. Author

N64-25915* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

FULL-SCALE WIND-TUNNEL TESTS OF NONARTICULATED HELICOPTER ROTOR

John L. Mc Cloud, III and James C. Biggers Washington, NASA, Jul. 1964 29 p refs

(NASA-TN-D-2392) OTS: $0.75

Full-scale wind-tunnel tests of a helicopter model having a nonarticulated rotor system have been conducted for forward speeds from about 5 to 160 knots. Basic force and moment data, along with the control power and corresponding cyclic loads in the hub, are presented for 1 g level flight conditions and for cyclic control sweeps about that point. For trim conditions, the collective and cyclic pitch requirements are shown as well as the variation of steady and cyclic hub loads with airspeed. The control moments obtained per degree of cyclic input were about eight times that obtainable with an articulated rotor and about 28% of that obtainable by a completely rigid rotor. Rotor hub loads were generally as predicted. Author

N64-25957 Naval Ordnance Lab., White Oak, Md.

ROLL DAMPING MOMENT MEASUREMENTS FOR THE BASIC FINNER AT SUBSONIC AND SUPERSONIC SPEEDS

Aerodynamics Research Report 59

F. J. Regan Jun. 1964 24 p refs

(NAVORD-6652; AD-600975)

Wind-tunnel measurements are presented of the aerodynamic roll damping moment coefficient derivative of the basic finner configuration. Data were obtained over the Mach range from 0.22 to 4.81. At four Mach numbers the roll damping moment coefficient derivatives were measured as a function of angle-of-attack with roll rate as a parameter. A free decay technique was used to obtain the data. The present results compare favorably with free-flight ballistics range data. Author

N64-26033* Michigan U., Ann Arbor

NATURAL FREQUENCIES IN COUPLED BENDING AND TORSION OF TWISTED ROTATING AND NONROTATING BLADES

G. Isakson and J. G. Eisley Washington, NASA, Jul. 1964 52 p refs

(Grant NsG-27-59)

(NASA-CR-65) OTS: $2.25

A Holzer–Myklestad type of procedure, using a matrix formulation, is developed for the determination of the natural vibration characteristics of a pretwisted rotating blade in coupled bending and torsion. The nonrotating blade is considered as a special case. Results of a limited parametric study are presented. In the case of the rotating blade there can be an appreciable effect of centrifugal forces in coupling the bending and torsional vibrations. To investigate the effects of Coriolis forces and the nonlinear effects of large angular displacements, a study is made on the basis of a simple model. Numerical results indicate that the Coriolis forces may introduce substantial phase differences between bending and torsional vibration. Limited numerical results on the nonlinear effects indicate that these effects decrease slightly the frequency of the characteristic motions as determined from a linearized analysis and introduce some coupling between the characteristic motions. Author

N64-26188 Stanford U., Calif.

A UNIFORMLY VALID SOLUTION FOR THE FLOW OVER AN INCLINED CONE USING THE METHOD OF MATCHED ASYMPTOTIC EXPANSIONS

A. G. Munson Apr. 1964 51 p refs

(Contract AF 49(638)-1274)

(AFOSR-64-1056; AD-603154)

The problem of flow over a circular cone inclined slightly to a uniform stream is solved using the technique of matched asymptotic expansions. The outer expansion is equivalent to Stone's solution of the problem. The inner expansion, valid in a thin layer near the body, represents Ferri's vortical layer. The solution to first order in angle-of-attack so obtained is uniformly valid everywhere in the flow field. In the second-order expansion an additional nonuniformity appears near the leeward ray. This defect is removed by inspection. The first-order solution is in agreement with that of Cheng, Woods, Bulakh, and Sapunkov. Formulas are given that may be used to render Kopal's numerical result uniformly valid to second order in angle-of-attack. A uniformly valid solution restricted to the hypersonic small-disturbance approximation is also given. Author

N64-26510 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

A CRUCIFORM WING OF FINITE SPAN IN A COMPRESSIBLE FLOW

B. I. Fridlender 13 Apr. 1964 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (USSR), v. 151, no. 6, 1963 p 1299–1302

(FTD-TT-64-127/1+2+4; AD-600502)

A thin, cruciform wing, consisting of four consoles of arbitrary geometric form, is considered. Each of the two sides of the consoles produce, in a supersonic flow, arbitrary harmonic oscillations of frequency ω. The potential of the disturbing velocity $\phi(x_1, y, z, t)$ is determined by using a linear equation proposed by Currant and Gilbert. R.T.K.

N64-26704 Aeronautical Research Council (Gt. Brit.)

ROLLING-POWER TESTS ON AN ELASTIC MODEL WING (M-PLANFORM) IN LOW-SPEED FLOW

D. R. Gaukroger, J. K. Curran, and A. T. Marriot London, HMSO, Aug. 1962 37 p refs

(ARC-R&M-3362; Replaces RAE-TN-STRUCT-280, ARC-24442) HMSO: 14s

Measurements and calculations of aileron effectiveness for an elastic model wing in low-speed flow are described. The experimental technique enabled rolling moments due to applied aileron and to rate of roll to be measured separately. Rolling moments were also calculated using measured flexibility coefficients and factored two-dimensional steady-flow aerodynamic derivatives. Experimental and calculated results were in good agreement. The wing tested was of M-planform, with two pairs of ailerons covering the inboard and outboard sections of the outer panels. The inboard ailerons were associated with a lower loss of control effectiveness. Author

N64-26745 Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (W. Germany) Inst. für Aerodynamik

INCREASE OF MAXIMUM LIFT OF A RECTANGULAR WING IN GROUND PROXIMITY BY COMBINED BLOWING AT THE LEADING EDGE AND AT THE NOSE OF THE FLAP [ERHOHUNG DES MAXIMALAUFTRIEBES EINES RECHTECKFLUGELS IN BODENNAHE DURCH KOMBINIERTES AUSBLASEN AN DER FLUGELNASE UND AN DER HINTERKANTENKLAPPE]

R. Löhr May 1964 39 p refs In GERMAN; ENGLISH summary (DLR-FB-64-02; DFL-64-64/9) Available from Zentralstelle für Luftfahrt-Dokumentation und Inform., Maria-Theresia-Str. 21, Munich, W. Germany: 11.50 DM

Wind-tunnel measurements were carried out on a rectangular wing with trailing edge flap situated between endplates in ground proximity. To increase the maximum lift by boundary-layer control, the wind was equipped with blowing slots at the leading edge and at the nose of the flap. The effectiveness of combined blowing at the leading edge and the nose of the flap with respect to lift increase was tested for a flap deflection of 60° with different ground distances. The results show that for a given quantity of blowing a greater increase of maximum lift can be produced when applying combined blowing than with blowing at the flap only. Author

N64-26758 Adelphi U., Garden City, N.Y.
AN ASYMPTOTIC METHOD FOR DETERMINING THE LIFT DISTRIBUTION OF A SWEPT-BACK WING OF FINITE SPAN
James K. Thurber May 1964 48 p refs
(Contract Nonr-3360(01))
(AGM-114; AD-600422)

Ciolkowski's asymptotic description of the contact surface that emanates from the airfoil in the neighborhood of the airfoil is extended to include the contributions from higher-order terms in the expansion parameter. The difficulty in the occurrence of an infinite downwash velocity is overcome, and explicit formulas for the distribution of circulation are obtained. In addition, the method of stretching used by Ciolkowski differs from the method used in this report. Ciolkowski used a uniform expansion of all three space coordinates in contrast to the variable expansion in two space coordinates used here. In a paper by F. Theilheimer, it is *a priori* assumed that the downwash velocity is finite, and that it is sufficient to know the circulation for a finite number of points of the airfoil in order to determine, with reasonable accuracy, the downwash velocity at points located midway between these points. In this connection, it is demonstrated that an effective angle-of-attack exists. Unfortunately, however, the circulation must be known in order to determine the effective angle-of-attack. I.v.L.

04 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc., and specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; safety devices; and stability and control. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

N64-25969* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AERODYNAMICS OF SPHERICAL BALLOON WIND SENSORS
James R. Scoggins Repr. from J. of Geophys. Res., v. 69, no. 4, 15 Feb. 1964 p 591–598 refs
(NASA-RP-228)

A preliminary analysis of the response characteristics of spherical balloon wind sensors is presented. It is shown that smooth superpressure spheres do not provide accurate detailed wind profiles and that the response characteristics can be improved by the addition of roughness elements. Experimental data show that surface roughness elements on a spherical balloon stabilize the drag force vector and reduce the lift force. Spurious aerodynamically induced motions are significantly reduced, and the balloon more accurately senses the true wind. IAA

N64-26051 Aeronautical Research Labs., Melbourne (Australia) Australian Defence Scientific Service
LOW VISIBILITY SIMULATION FOR PILOT TRAINING
J. R. Baxter and R. W. Cumming Mar. 1964 21 p refs
(ARL/HE-17)

A training device that can be rapidly installed in airline or operational service aircraft was developed to simulate the visibility conditions generally encountered in operation to low weather minima—a fog or haze condition in which the clarity of ground objects decreases with distance from the aircraft until they fade from view at some maximum visual range. The existing prototype equipment can be fitted to a Boeing 707 in about 15 minutes, the only connections to the aircraft systems being to the 115- and 28-v a.c. power supplies and to a static pressure source for altitude reference. The system was designed around a novel type of graded opacity screen insensitive to the pilot's eye height, and an optical sight aimed at the natural horizon is ued to provide a horizontal reference. Initial flight trials indicated that this principle of simulation is sound and the design of a production model, based on the prototype with some mechanical modifications, can be started. In parallel with this a gyroassisted version would not depend upon a clear horizon and continuous manual tracking should also be developed. Author

N64-26099 Canadian Armament Research and Development Establishment, Valcartier
NOTES ON THE ACCURACY OF DRAG AND STABILITY MEASUREMENTS IN A BALLISTICS RANGE
R. Montgomery Dec. 1963 33 p
(ARPA Order 133)
(CARDE-TR-485/63)

Two basic methods of estimating drag coefficients from ballistics range data are analyzed to find the maximum errors involved. It appears that a technique in which the drag of the object under consideration is measured relative to the known drag of another object is more accurate than the simple time-distance method. An analysis of errors involved in the extraction of stability derivatives from oscillatory data indicates that these errors can be expressed in terms of the errors in the measurement data. Author

N64-26277 Lightning and Transients Research Inst., Minneapolis, Minn.
LIGHTNING PROTECTION MEASURES FOR AIRCRAFT FUEL SYSTEMS. PHASE I
A. M. Newman, J. D. Robb, and J. R. Stahmann Washington, FAA, May 1964 101 p refs
(Contract FA-64WA-4955)
(FAA-ADS-17)

Lighning is receiving increased recognition as a possible hazard to aircraft, and an intensive 4-month program covered in this report demonstrated the existence of possible ignition sources in a typical aircraft wing tank section and of some feasible ignition source reduction measures. The tests, carried out on a typical jet transport fuel system, showed up ignition possibilities produced by lightning that were essentially common to all aircraft, with direct stroke discharges to such points as fuel filler caps, access doors, and semi-insulated rivets producing sparks and molten aluminum showers inside the fuel

tank, and discharge streamers presenting ignition sources near fuel vent openings. Sparking was also demonstrated possible at semi-insulated joints and fastenings in areas that may contain trapped fuel vapors adjacent to the fuel tank. Strokes were directed to points near the flux gate unit and into a broken navigation light bulb to obtain maximum possible induced effects from wiring near fuel gage wiring. Induced effects on fuel gage wiring did not prove excessive by a factor of about 10 on the particular wing tested. Author

N64-26294 Aeronautical Research Inst. of Sweden, Stockholm
SONIC-BOOM WAVES IN STRONG WINDS
Robert F. Dressler Oct. 1964 22 p refs
(FFA-97)

Variable atmospheric conditions of winds and temperatures can cause a wide scatter about average values of sonic-boom intensities at ground level. This is analyzed quantitatively for a common atmospheric model—wind velocity increasing linearly with altitude, constant wind direction, and linear temperature variation (the PBB model). Winds introduce non-isotropy and convection into acoustic propagation, modifying simple geometrical acoustic theory so that rays no longer remain orthogonal to wavefronts. A brief survey is sketched of generalized geometrical acoustics derived from weak-shock theory, with quadratic wave-normal surfaces, the generalized Eiconal equation, and associated six Hamiltonian equations for rays and wave normals. Previous sonic-boom calculations with winds have not used this exact formulation, employing instead an approximation, due to Rayleigh, valid for small ray angles and small wind velocities, that is commonly applied to atomic blast calculations. A computer program was developed that solves each sonic-boom propagation pattern for arbitrary wind and temperature distribution in less than a half minute. Results on the PBB model for five wind directions show that the variations from headwind to tailwind are almost 5:1 for energy intensity, and 2.2:1 for overpressures. Energy intensity absorbed by the horizontal surface, however, remains constant for this model. Author

N64-26321 Technology, Inc., Dayton, Ohio
STRUCTURAL FLIGHT LOADS DATA FROM C-130 AIRCRAFT
Larry E. Clay and Alan P. Berens Wright-Patterson AFB, Ohio, ASD, Apr. 1964 265 p refs
(Contract AF 33(657)-9845)
(ASD-TDR-64-78; AD-600470)

This report discusses a C-130 flight loads program conducted to obtain, process, and analyze data of three in-flight variables—normal acceleration at the aircraft's center of gravity, altitude, and airspeed. From four C-130 models—C-130A, C-130B, JC-130, and HC-130G—8,155 hrs of usable data were acquired. Presented in this report are a history of the data recording and discussions of the techniques for data recording, processing, and analyzing. None of the models yielded any data exceeding the design limit load factors. The various airbase locations appreciably affected the gust spectra. In the lower load-factor range of the C-130A and C-130B data, the gust spectrum was more severe than the maneuver spectrum. Author

N64-26412* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLIGHT TESTS OF A 0.13-SCALE MODEL OF A VECTORED-THRUST JET VTOL TRANSPORT AIRPLANE
Charles C. Smith, Jr., and Lysle P. Parlett Washington, NASA, Aug. 1964 42 p ref Film Supplement to this Report is Available on Loan from Langley Research Center (ASA-TN-D-2285) OTS: $1.00

The investigation consisted mainly of free-flight model tests, but a few force tests were made to help explain some of the flight-test results. Hovering flight in and out of ground effect can be performed smoothly and easily. Transitions can be made smoothly and consistently, although the model had neutral static longitudinal stability in the low-speed part of the transition range. In low-speed conventional flight, the stability and control characteristics of the model were generally satisfactory except that the model evidenced random yawing motions that were annoying but not dangerous. Short takeoffs and landings could be made easily. Author

N64-26416* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL INVESTIGATION OF THE DYNAMIC STABILITY OF A TOWED PARAWING GLIDER AIR CARGO DELIVERY SYSTEM
Robert E. Shanks Washington, NASA, Aug. 1964 48 p refs Film Supplement to this Report is Available on Loan from Langley Research Center
(NASA-TN-D-2292) OTS: $1.25

An investigation of the tow and free-flight characteristics of a parawing glider was made in the Langley full-scale tunnel by means of a flying model, and force tests were made to determine the static and dynamic stability characteristics of the model for correlation with the flight results. The addition of vertical side area in the plane of symmetry beneath the wing could provide satisfactory tow characteristics. Free-flight tests of the model showed that sustained flights could be made in the tunnel with coordinated wing-bank and rudder control. Author

N64-26503 Federal Aviation Agency, Atlantic City, N.J. Systems Research and Development Service
EVALUATION OF THE BLEU AUTOMATIC LANDING SYSTEM Final Report
J. Ridas Vice and James C. Muir Dec. 1963 99 p
(AD-600829)

Included are a description of the operational procedures used with the DC-7 during approaches for automatic landings; a general description of the additional airborne electronic equipment required for automatic landings; histograms, graphs, and statistical comparisons that describe the performance of the system at touchdown and over the final portion of the approach and landing path; and data obtained from pilots and other observers during automatic landings made on an instrument-landing-system installation, presenting various types of approach terrain. R.T.K.

N64-26628* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INTERFERENCE EFFECTS OF SINGLE AND MULTIPLE ROUND OR SLOTTED JETS ON A VTOL MODEL IN TRANSITION
Raymond D. Vogler Washington, NASA, Aug. 1964 75 p refs
(NASA-TN-D-2380) OTS: $2.00

Data were obtained through an angle-of-attack range, with 10 different geometric arrangements of single and multiple nozzles in the bottom of the model fuselage, with and without jet deflection. The ground effects at zero forward speed without jet deflection were also obtained. Lift losses

and pitching-moment increments occurred at forward speeds out of ground effect and while hovering in ground effect. The jet configurations consisting of longitudinal slots and the four-jet diamond pattern among the multiple round jets showed less adverse effects than the other arrangements. Author

N64-26656 General Electric Co., Cincinnati, Ohio Advanced Engine and Technology Dept.
XV-5A LIFT FAN FLIGHT RESEARCH AIRCRAFT Quarterly Technical Progress Report, Aug. 16–Nov. 15, 1963
31 Dec. 1963 90 p refs
(Contract DA-44-177-TC-715)
(QTPR-8; AD-437623)

The manufacture and acceptance testing of the propulsion system was completed. Propulsion system support was expanded during the aircraft ground tests. Flight test program details and a revised program schedule were completed and submitted. Full-scale wind-tunnel test preparations are well underway with the necessary test hardware and instrumentation being manufactured. Static structural tests and ground resonance tests of the aircraft were completed. Numerous structural stress, and model test reports were completed and issued. Installation of all aircraft electrical and hydraulic components was made in the simulator with approximately 30 hrs of operating time. Author

N64-26659 Bell Aerosystems Co., Buffalo, N.Y.
STUDY OF REQUIREMENTS FOR VTOL RESEARCH SIMULATOR FOR THE STUDY OF CONTROL AND DISPLAY PROBLEMS
W. E. Powe, J. Burgess, R. Seguin, N. Carriero, and G. Malecki Apr. 1963 334 p refs
(Contract NOAS-57-836-c)
(Rept.-2120-920002; AD-437691)

The present study was undertaken to define the functional characteristics of a research simulator that would provide a capability for studying the control and display problems associated with the entire spectrum of horizontal attitude V/STOL aircraft. Data were derived that should clarify operator behavioral limitations, establish partial display requirements for V/STOL aircraft, and assist in the formulation of significant problems for V/STOL simulator investigation. The appendixes present abstracts of orientation and objectives, context for reviews of pertinent data, problem areas and literature sources, organization of material, control problems, display problems, analytical methods, and the equations of motion and aerodynamic parameters for four VTOL aircraft—the Bell Model 2000 VTOL fighter aircraft. I.v.L.

N64-26664 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
THE AERODYNAMIC DESIGN AND FLIGHT DEVELOPMENT OF THE BREGUET 941 STOL AIRCRAFT [ETUDE AERODYNAMIQUE ET MISE AU POINT EN VOL DE L'AVION STOL BREGUET 941 (I)]
J. Czinczenheim London, Min. of Aviation, Apr. 1964 30 p refs Transl. into ENGLISH from Tech. Sci. Aeronaut. Spatiales (Paris), no. 33, 1963 p 187–202 Lecture Presented to the Helicopter Comm. of AFITAE
(RAE-TRANS-1063)

The Breguet 941 short takeoff and landing aircraft is described. High lift coefficients are obtained by lowering the flaps and ailerons to deflect the slipstream from four interconnected propellers. The takeoff and landing techniques are discussed and performance measurements presented. Consideration is also given to the cruise performance. The flying qualities at low speed, with measurements of the static and dynamic stability and control, are compared with the AGARD requirements for V/STOL aircraft. Author

N64-26670 Miller Research Corp., Baltimore, Md. Miller Research Labs.
PRODUCTION COMPONENTS FOR CARTRIDGE, 81mm ILLUMINATING XM-512 SUMMARY REPORT
E. R. Briggeman Jul. 1963 94 p
(Contract DA-36-034-ORD-3468-RD)
(SR-251-1-63; AD-437574)

The distinguishing characteristics of the XM-512 illuminating cartridge are described. They are an aluminum tail cone and candle case and a unique parachute designed to eliminate parachute malfunctioning. A history of the testing of the cartridge is presented, and a detailed description of manufacturing procedures that lead to the fabrication of the cartridge is included. R.T.K.

N64-26698 Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (W. Germany) Inst. für Flugmechanik
A COMPILATION OF RESULTS OBTAINED FROM FLIGHT TESTS WITH THE NORTH AMERICAN X-15A AIRCRAFT TYPE [ZUSAMMENSTELLUNG VON ERGEBNISSEN DER FLUGERPROBUNG DES MUSTERS NORTH AMERICAN X-15A]
H. Herb May 1964 30 p refs IN GERMAN
(DLR-MITT.-64-02) Available from Zentralstelle für Luftfahrt-Dokumentation und Inform., Maria-Theresia-Str. 21, Munich, W. Germany: 6.50 dm

The X-15A is actually the most rapid manned aircraft type with speeds exceeding Mach 6 and flight altitudes of more than 80 km. When in 1958 classification was cancelled for this prototype, a number of publications appeared giving interesting details on the X-15A. In particular, exact data were published on the progress of the flight tests. As there are hardly any publications as detailed as these in German literature of aeronautics, some material of general interest concerning the aircraft type X-15A was compiled. A great number of results obtained from flight tests with the X-15A are also of importance for space flight engineering. Author

N64-26726 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
DYNAMICS OF THE AIRPLANE, I
V. P. Vetchinkin 30 Apr. 1964 585 p refs Transl. into ENGLISH of the Book "Dinamika Samoleta, I" Moscow, Izd Akad. Nauk SSSR, 1956 p 5–422
(FTD-TT-63-727/1+2; AD-601755)

Topics discussed in this book include these: (1) the atmosphere; (2) fundamental aerodynamic data—the resistance of fluids with respect to bodies moving in them, and wings and the forces acting on them; (3) the motion of an aircraft on the ground or near the ground; (4) the pancake landing of an aircraft; (5) the undercarriage; (6) motion in a vertical plane; (7) turns and helices; (8) the steady motion of an aircraft, taking into account its change in weight due to the combustion of gasoline; (9) the problem of aircraft dive, taking into account density change due to altitude; (10) gliding range and gliding time (from high altitude); (11) the flight path of an air reconnaissance for covering the maximum area with a given wind; (12) jet aircraft dynamics; (13) the vertical motion of rockets; (14) the flight of a winged rocket at supersonic speeds; and (15) aircraft longitudinal vibrations and longitudinal dynamic stability (the motion of aircraft having several degrees of freedom, aircraft or aircraft model longitudinal vibrations in a wind tunnel, and aircraft longitudinal vibrations in air). I.v.L.

N64-26738 Princeton U., N.J.
AN EXPLORATORY STUDY OF INSTRUMENT APPROACHES WITH STEEP GRADIENT AIRCRAFT
E. Seckel, J. J. Traybar, and G. E. Miller Ft. Eustis, Va., Army Transportation Res. Command, Oct. 1963 37 p refs
(Contract DA-44-177-TC-834)
(Rept.-630; TRECOM-TR-63-28; AD-437622)

A series of flight tests were conducted to determine the influence of certain parameters and quickened cross-pointer presentations on instrument approaches with steep gradient aircraft. Approximately 50 hooded instrument approaches were flown using a single-rotor helicopter piloted by a highly experienced NASA test pilot. Standard flight instruments were used, and the tracking presentation for the pilot consisted of an ILS type cross-pointer indicator. Parallel beam patterns as well as the standard angular, wedge-shaped ILS beam patterns were simulated by a tracking theodolite system coupled to the aircraft cross-pointer by a radio link. Numerous beam widths, glide slope inclination angles, and quickening inputs were investigated. The maximum glide slope inclination angles studied were in the 8° to 11° range because of operational limitations of the aircraft and task (30 knots minimum airspeed and 500 fpm maximum rate of descent). Parallel beam patterns (constant sensitivity) were preferred over the standard angular wedge-shaped beam patterns (sensitivity varying with range from transmitter). No significant improvements were obtained with the quickened presentation in preference to the pure displacement presentation. Author

N64-26773* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FORCE-TEST INVESTIGATION OF A 1/4-SCALE MODEL OF THE MODIFIED VZ-2 AIRCRAFT
Robert H. Kirby, Robert O. Schade, and Louis P. Tosti Washington, NASA, Aug. 1964 73 p refs
(NASA-TN-D-2382) OTS: $2.00

A force-test investigation was conducted to determine the longitudinal aerodynamic characteristics and the aileron control effectiveness of a 1/4-scale model of the modified VZ-2 tilt-wing vertical-take-off-and-landing aircraft equipped with a full-span slotted flap. The model was also tested over the transition range with a leading-edge droop modification. The results of the force tests indicated that the use of full-span slotted flaps produced sizable increases in lift that resulted in considerable reductions in the wing incidence angles required throughout the transition range; and these reductions in wing incidence were very beneficial in reducing wing stalling in the transition range. The use of leading-edge droop had no appreciable effect on the static longitudinal characteristics. The use of full-span ailerons as a yaw control for hovering and low-speed transition flight appears to offer considerable promise; however, the phasing in of some roll producing control is necessary fairly early in the transition, to eliminate the adverse roll that is encountered. Author

N64-26840* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF WING STALLING IN TRANSITION ON A 1/4-SCALE MODEL OF THE VZ-2 AIRCRAFT
Robert O. Schade and Robert H. Kirby Washington, NASA, Aug. 1964 32 p refs
(NASA-TN-D-238) OTS: $1.00

An experimental flight investigation was conducted to determine the dynamic lateral stability and control characteristics of a remotely controlled 1/4-scale model of the VZ-2 tilt-wing vertical-takeoff-and-landing aircraft. The model was equipped with a full-span slotted flap and a Krueger-type nose flap. The investigation included both level-flight and descent conditions over the transition range where wing stalling occurred. Flight tests of the model in the flaps-retracted configuration indicated that the model had poor lateral flight characteristics in level flight and that these characteristics became worse during descent. These poor lateral characteristics generally consisted of wing dropping and erratic large-amplitude yawing motions normally associated with wing stall. The full-span slotted flap and the Krueger-type nose flap when used in combination resulted in large improvements in lateral flight characteristics in both level and descent flights. When the two types of flaps were used separately the lateral flight characteristics did not improve as much as when the flaps were used in combination. Of the two types of flaps, the full-span slotted flap produced the greatest improvement in lateral flight characteristics. Use of the full-span slotted flap, however, caused a considerable reduction in longitudinal flight characteristics. When the mode of propeller rotation was such that the blades were going upward at the wing tips, the wing-dropping tendency was worse but the yawing characteristics were better than when the blades were going downward at the wing tips. Author

05 ASTRONOMY AND ASTROPHYSICS

Includes celestial mechanics; and radioastronomy. *For related information see*: 12 Geophysics, and 29 Space Sciences.

N64-25857 Liege U. (Belgium) Institut d'Astrophysique
DETERMINATION OF SMOOTH DISTRIBUTIONS OF ATMOSPHERIC OZONE FROM THE ABSORPTION AND EMISSION OF THE 9.6 MICRONS BAND
E. Vigroux 31 May 1963 165 p refs
(Contract AF 61(514)-962)
(AFCRL-64-88; TN-1; AD-438413)

Methods for the determination of the smoothed vertical distribution of atmospheric ozone from observation in the infrared, at low dispersion, in the 9.6μ band region are presented. Absorption of ozone, absorption by water vapor, emission of ozone, and temperature and humidity soundings are discussed. Auxiliary calculations were made as well as primary ones based on total ozone content, the equivalent width of the 9.6μ ozone absorption band as observed in a known direction, and the absolute emission of the 9.6μ ozone band as observed in a series of known directions. G.D.B.

N64-25921 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
ROTATIONAL ENERGY LEVELS OF ASYMMETRIC TOP MOLECULES TABLES OF REDUCED ENERGIES. PART IV: FOR J = 10 TO 13
M. Sidran, F. Nolan, and J. W. Blaker Mar. 1964 263 p
(RE-172)

A table of reduced energies for asymmetric top molecules, for J = 10 to 13 and intervals of 0.001 in kappa, is presented. All eigenvalues given in the table refer to the ground vibrational state and assume no centrifugal distortion. It is claimed that no entry has a relative error greater than 8×10^{-8} or an error in its final digit as large as 3 with the vast majority of the numbers being correct for all digits given. P.V.E.

N64-25956* Columbia U., Palisades, N.Y. Lamont Geological Observatory

A MULTI-LAYER MODEL FOR THE STUDY OF ACOUSTIC-GRAVITY WAVE PROPAGATION IN THE EARTH'S ATMOSPHERE

Richard L. Pfeffer Repr. from J. Atmospheric Sci., v. 19, no. 3, May 1962 p 251–255 refs

(Grants NsG-160-61; NSF G-9412; Contract Nonr-266(70))

An iterative numerical procedure, suitable for use on electronic computers, is presented for calculating the horizontal propagation speeds of acoustic-gravity waves in a stratified atmosphere. The atmosphere is represented by an arbitrarily large series of isothermal layers, so that propagation can be readily studied in an atmosphere with a complex stratification. The basic approach is similar to that used in seismology. A sample calculation shows reasonable agreement with the exact two-layer solution of Pekeris. Author

N64-26052* Consultants and Designers, Inc., Arlington, Va.

DESTINIES OF STARS AND GALAXIES [SUD'BY ZVEZD I GALAKTIK]

B. Konovalov and L. Kornilou 25 Feb. 1964 11 p Transl. into ENGLISH from Nedelya (Moscow), 9–15 Feb. 1964

(Contract NAS5-2078)

(NASA-TT-F-8697; ST-ISG-10116)

This is a series of general statements by a group of Soviet astronomers in response to questions from a Russian newspaper Sunday supplement. Some general cosmogenic theories are briefly discussed. G.D.B.

N64-26072* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

REVIEW OF DIRECT MEASUREMENTS OF INTERPLANETARY DUST FROM SATELLITES AND PROBES

W. M. Alexander, C. W. Mc Cracken, L. Secretan, and O. E. Berg Repr. from "Space Res., III", Amsterdam, North Holland Publ. Co., 1963 Presented at the 3rd Intern. Space Sci. Symp., Washington, 30 Apr.–9 May 1962

(NASA-RP-234)

Direct measurements of selected parameters of interplanetary dust particles have been obtained from experiments on rockets, satellites, and deep space probes. All the available data show excellent agreement when analyzed with respect to the dust particle measurements obtained from Explorer VIII. From this analysis, an average cumulative mass distribution curve for dust particles in the vicinity of the earth was established. The measured mass distribution presents two predominant features. First, the distribution departs markedly from what is expected from extrapolations of meteor data, and second, the accretion of interplanetary material by the earth is dominated by the small dust particles. Author

N64-26078* National Aeronautics and Space Administration, Washington, D.C.

TEMPERATURE OF METALLIC OBJECTS IN SPACE

Raymond H. Wilson, Jr. Repr. from Sci., v. 144, no. 3614, 3 Apr. 1964 p 80–81 refs

(NASA-RP-258)

Briefly considered is the temperature of an iron meteoroid just before entering the earth's atmosphere, taking into account the effect of the shadow of the earth. It is noted that the failure, by Butler and Jenkins, to consider this factor, would seem to seriously modify some of their conclusions. It is suggested that the temperature of an iron meteoroid just before atmospheric penetration, may be anywhere from about 90° C down to much below the freezing point of water, depending upon its size and the duration of its preceding eclipse in the earth's shadow. IAA

N64-26301* Massachusetts Inst. of Tech., Cambridge, Mass. Research Lab. of Electronics

HIGH-RESOLUTION MICROWAVE SPECTRA OF H AND OH ABSORPTION LINES OF CASSIOPEIA A

A. H. Barrett, M. L. Meeks, and S. Weinreb (Lincoln Lab., MIT) Repr. from Nature, v. 202, no. 4931, 2 May 1964 p 475–476 refs

(Grant NsG-419; Contract DA-36-039-AMC-03200(E))

The −0.8 km/s absorption line from Cassiopeia A, at both the H and OH line frequencies was investigated. The line spectra were obtained with equivalent filter widths of 7.5, 3.75, and 1.87 kc/s. It was noted that the H-absorption line was asymmetrical and could be considered as being composed of two or more lines. It was found that the OH absorption line was in reality composed of two lines, separated by 7.5 kc/s, having approximately equal intensities, and having line widths (full-width at half maximum) of 4.2 kc/s and 4.8 kc/s after correction for receiver resolution. These observations were used to separate, in a definite manner, the thermal and turbulent velocities of the absorbing clouds, thus yielding a reliable determination of the kinetic temperature within the clouds. I.v.L.

N64-26314* National Aeronautics and Space Administration. Goddard Inst. For Space Studies, New York N.Y.

RADIATIVE TRANSFER IN THE ATMOSPHERES OF VENUS AND MARS

R. Jastrow and S. I. Rasool [1962] 6 p refs Reprinted Previously Published as N64-11650 03-29

(NASA-RP-251)

An approximate theory of radiative transfer in planetary atmospheres is developed and applied to atmospheres of Venus and Mars. The results for Venus indicate that the atmosphere of that planet must have an optical thickness of 60 in the infrared, corresponding to a transmission of 10^{-26}, to produce the observed surface temperature of 600° K. The surface temperature and tropopause height of Mars are also investigated. Author

N64-26362* Cornell Aeronautical Lab., Inc., Buffalo, N.Y.

A STUDY OF METEOROID IMPACT PHENOMENA Quarterly Progress Report, 14 Jun.–14 Sep. 1962

William J. Rae [1962] 72 p refs

(Contract NAS3-2121)

(NASA-CR-58059; CAL-RM-1655-M-3) OTS: $7.60 ph

Modern blast-wave theory is applied in an examination of the phenomena that occur when meteoroids collide with satellites and other space vehicles. The blast-wave is developed and includes the strong interactions between fluid dynamic effects and material properties during very high energy collisions. The nature and extent of the processes that result in crater formation are discussed. R.T.K.

N64-26419* National Aeronautics and Space Administration, Washington, D.C.

STUDY OF THE PLANETS BY MEANS OF THE POLARIZATION OF THEIR LIGHT [ETUDE DES PLANETES PAR LA POLARISATION DE LEUR LUMIERE]

Audouin Dollfus (ph.D. Thesis—Paris U., 1955) Jul. 1964 137 p refs Transl. into ENGLISH

(NASA-TT-F-188) OTS: $2.75

The instruments developed permit the measurement of the ratio of polarized light and the direction of the favored vibration in small regions of the surface of the disks of planets, and within limited spectral regions. Measurements performed from 1948 to 1954 on Mercury, Venus, Mars, Jupiter, and lunar earthshine were compared with the determinations made on terrestrial samples. The natures of their soils and clouds and the densities of their atmospheres could thus be specified. Author

N64-26425 RAND Corp., Santa Monica, Calif.
RADIAL DISCRETIZATION IN SPHERICAL GALAXIES
T. Y. Thomas May 1964 8 p refs Submitted for Publication (RM-4110-RC; AD-600372)

This note is concerned with the deviations from a static metric that are produced in the world tube of spherical galaxies by influences of a cosmological nature. The procedure used in the derivation of the periods $2\pi/c\ (Rm/\sqrt{n(n+1)})$, (m,n = 1,2,3, . . .) (1) (where c is the velocity of light, R is the radius of a spherical galaxy, and m and n are, as indicated, positive integers) of the wave function ψ in the world tube of the spherical galaxy is extended to the world tube W to yield the result that the universe as a whole will have the basic period $2\pi/c\ (\pi R(v)/2/\sqrt{N(N+1)}) = \pi^2 R(v)/c\sqrt{N(N+1)})$ (N = 1,2,3, . . .). (2) The R(v) can be thought of as the average radius of curvature of the universe in *vth* cosmological epoch. The periodic effects of periodicity (2) will therefore be produced in the metric structure of the galaxian world tube as the result of cosmological influences; hence, one of the periods (1) of the function ψ must be equal to the period (2). $R = \kappa M(v)\sqrt{n(n+1)}/4\pi m\sqrt{N(N+1)}$ is then obtained as the equation for the discretization of the radii of spherical galaxies in the *vth* cosmological epoch where $M(v)$ is the total mass in the universe during this epoch and κ is the usual constant that occurs in the field equations. I.v.L.

N64-26450 Space Technology Labs., Inc., Redondo Beach, Calif. STL Technical Library
THE EXPANSION OF H II REGIONS AND THE FORMATION OF PERIPHERAL STRUCTURES IN DIFFUSE NEBULAE [RASSHIRENIE OBLASTEI H II I OBRAZOVANIE PERIFERIINYKH STRUKTUR V DIFFUZNYKH TUMANNOSTYAKH]
R. E. Gershberg Jan. 1964 21 p refs Transl. into ENGLISH from Izv. Krymskoi Astrofiz. Obs., v. 25, 1961 p 76–87 (STL-Trans-79; STL-9990-6584-TU-000)

The evolution of the H II region around an early type star, which burst out in an extended H I region, is investigated. In such a system, the hydrodynamic effects develop after the formation of the Strömgren zone; this reduces to zero the effectiveness of rocket acceleration mechanism of interstellar clouds. Expansion of the initial H II zone decreases its optical thickness in L_c and generates ionization of the new masses of gas. The freshly ionized gas penetrates into the outer layers of the initial H II zone. This process can explain the formation of peripheral structures observed in the diffuse nebulae of the IC 1805 and IC 1848 types. Author

N64-26541* Consultants and Designers, Inc., Arlington, Va.
TO THE RADIO EMISSION THEORY OF VENUS AND MARS [K TEORII RADIOIZLUCHENIYA VENERY I MARSA]
V. S. Troitskiy 13 Jul. 1964 13 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz. (Gor'kiy), v. 7, no. 2, 1964 p 208–214
(Contract NAS5-2078)
(NASA-TT-F-8923; ST-LPS-RA-10170)

The phase dependence of radio emission of Venus' and Mars' surfaces is considered in the assumption of existence of a given periodical temperature regime of the surface. As a result of experimental data on phase dependence of Venus' radio emission and location data on the reflection factor, the period of Venus' proper rotation was estimated to be near 2 to 10 days at reverse rotation. Author

N64-26551 Instituto y Observatorio Astronomico de Marina, San Fernando (Spain)
ASTRONOMICAL CALENDARS FOR THE YEAR 1965 [EFEMERIDES ASTRONOMICAS ANO 1965]
1964 547 p *Its* Vol. CLXXIV In SPANISH Available from Inst. y Obs. Astron. de Marina: 85 Pesetas, Spain; 100 Pesetas, Other

This astronomical almanac for 1965 contains the positions that have been computed for the celestial bodies (sun, moon, planets, etc.) for each day of the year. Information is included on the times of the rising and setting of the sun and moon, as will as for the occurrence of eclipses. R.T.K.

N64-26554 Institute of Theoretical Astronomy (USSR)
EPHEMERIDES OF MINOR PLANETS FOR 1965 [EFEMERIDY MALYKH PLANET NA 1965 GOD]
Moscow, Nauka, 1964 154 p In RUSSIAN; ENGLISH Introduction

This volume contains the elements of all numbered minor planets, the dates of their oppositions, the ephemerides of planets that will be in opposition during 1965, and the status of observations of minor planets as of January 1, 1964 I.v.L.

N64-26568 Observatorium Bosscha, Bandung (Indonesia)
NEW H-ALPHA EMISSION STARS IN A REGION TO THE EAST OF THE T-ASSOCIATION NEAR RHO OPHIUCHI
Pik-Sin The and Ham Keng Lim Repr. from Proc. of the Bandung Inst. of Tech v. 3, no. 1, 1964 p 35–43 refs *Its* Contributions no. 23

The result of a survey of H-alpha emission objects in an area of approximately 25 square degrees centered on the star CD-24° 12765 (R.A. = 16^h38^m5; Dec. = − 24° 22'; 1950), is presented. Only 33% of the previously discovered H-alpha emission stars located in the present survey region were redetected. A total number of 32 new H-alpha emission objects were found. Their positions and finding charts are given. Author

N64-26569 Observatorium Bosscha, Bandung (Indonesia)
NOTE ON A GROUP OF FAINT Hα-EMISSION STARS ASSOCIATED WITH A DARK NEBULOSITY IN OPHIUCHUS
Pik-Sin The 1964 3 p refs *Its* Contributions No. 27

A group of 8 faint Hα-emission stars situated close or in a dark nebulosity in Ophiuchus is found. It is believed that this group forms a T-association. Author

N64-26570 Observatorium Bosscha, Bandung (Indonesia)
IDENTIFICATION CHARTS FOR PLANETARY NEBULAE
Pik-Sin The 1964 6 p refs Repr. from Proc. of the Bandung Inst. of Tech., v. 3, no. 2, 1964 p 1–5 refs *Its* Contributions No. 29

Identification charts are presented for 12 known planetary nebulae of uncertain locations. The plates taken for these identifications are of the Eastman Kodak 103E type, exposed for 20 minutes behind a 2-mm Schott RGI filter.

The 6° objective prism, together with this plate-filter combination, gives spectra of stars, of which the H-alpha line is located just on the red end of the spectrum; the spectra are unwidened. I.v.L.

N64-26571 Observatorium Bosscha, Bandung (Indonesia)
NINE NEW PLANETARY NEBULAE
Gordon L. Vandervort 1964 5 p refs *Its* Contributions no. 30

Nine new H−α emission objects that show no continuum, tentatively identified as planetary nebulae, were found in a region of approximately 90 square degrees centered at R.A. = 17^h00^m, Dec. = −40° (1950). The coordinates, red magnitudes, and identification charts of these objects are given. Author

N64-26593* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE IRON, MAGNESIUM, AND CALCIUM, DISTRIBUTION IN COEXISTING OLIVINES AND RHOMBIC PYROXENES OF CHONDRITES
Klaus Keil and Kurt Fredriksson (California U., San Diego) [1964] 80 p refs
(Grants NsG-322-63; NsG-317-63)
(NASA-TM-X-54037) OTS: $7.60 ph

Iron, magnesium, and calcium were analyzed in olivines and pyroxenes of 95 chondritic meteorites with an electron microprobe. Of these, 86 were 'ordinary' chondrites, each of which has constant iron–magnesium ratios in olivine and pyroxene. Between different meteorites these ratios vary within three narrow ranges, which reflect the H- and L-group chondrites, as well as a third group, designated the LL-group. The ratio of iron in olivine to that in coexisting pyroxene is nearly constant (~1.1), particularly within the groups mentioned. Based on the amount of iron in silicates and metal, a classification of stony meteorites is proposed. Author

N64-26599* IIT Research Inst., Chicago, Ill. Astro Sciences Center
SCIENTIFIC OBJECTIVES FOR MERCURY MISSIONS Digest Report
T. C. Owen 30 Apr. 1964 48 p refs
(Contract NASr-65(06))
(NASA-CR-58121; P-6) OTS: $4.60

Work in the following areas is summarized: (1) solid state device design; (2) materials research; (3) band structure and spectroscopy of solids; (4) spectroscopy of magnetic solids; (5) transition-metal and rare-earth compounds; and (6) optics and infrared. P.V.E.

N64-26676 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
THE TWO VARIABLE EXPANSION PROCEDURE FOR THE APPROXIMATE SOLUTION OF CERTAIN NON-LINEAR DIFFERENTIAL EQUATIONS
J. Kevorkian 3 Dec. 1962 119 p refs Presented at the Summer Inst. in Dynamical Astronomy, New Haven, Conn., 1962
(Grant AF-AFOSR-62-256)
(SM-42620; AD-437675)

A method is presented for deriving the asymptotic representation valid for large times for the motion of a particle under the influence of a predominantly linear restoring force and small nonlinear perturbations. Such an asymptotic representation must be a function of two time variables to depict the behavior of the solution. The basic ideas are explained by the liberal use of simple examples, and the method is also applied to two idealized problems in celestial mechanics. Author

N64-26767* Consultants and Designers, Inc., Arlington, Va.
DISTRIBUTION OF METEORS ACCORDING TO STELLAR MAGNITUDE [RASPREDELENIYE METEOROV PO ZVEZDHYM VELICHINAM]
M. Kalinkov 24 Jun. 1964 5 p refs Transl. into ENGLISH from Astronom. Zh. (Moscow), v. 41, no. 2, 1964 p 419–421
(Contract NAS5-2078)
(NASA-TT-F-8915; ST-IM-10161)

Estimates of κ within the limits of stellar magnitude -5^m to $+12^m$ are given. These are based on data on 319,000 meteors available in various papers. In the -4^m to $+3^m$ interval the luminosity function cannot be approximated by an exponential function. Author

N64-26788* Consultants and Designers, Inc., Arlington, Va.
STRUCTURE OF THE SUPERCORONA
V. V. Vitkevich 20 Jul. 1964 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), no. 5, 1956 p 1065–1067
(Contract NAS5-2078)
(NASA-TT-F-8935; ST-SP-10175)

Included in this report are the following: (1) a comparison of the variation of the electron concentration as a function of the distance from the center of the sun, according to optical and radio data; (2) an analysis of how the scattering angle of radio waves in the supercorona varies as a function of distance and the determination of the value of the exponent for the scattering angle for the radio interference bases east-west; and (3) an analysis of the radial component of inhomogeneities that create scattering in a direction perpendicular to the radial one. Also, a supercorona in the form of two electron components is considered. One component is the diffusion medium with a uniform distribution of electron concentration. In this case, the propagating radio waves do not undergo scattering. The second component is in the form of radial beams with an electron concentration exceeding that of the diffusion medium. These radial inhomogeneities cause scattering. I.v.L.

N64-26789* Consultants and Designers, Inc., Arlington, Va.
FORBIDDEN TRANSITION LINES LINKED WITH THE FIRST EXCITED sp^2 CONFIGURATIONS IN CORONAL ISOELECTRON SEQUENCES. QUADRUPOLE TRANSITIONS IN sp^2 CONFIGURATIONS
A. A. Nikitin and O. A. Yakubovskiy 3 Aug. 1964 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), no. 4, 1964 p 760–762
(Contract NAS5-3760)
(NASA-TT-F-8937; ST-SP-10184)

The first excited configurations in the isoelectron sequences B I, C II, N III, . . ., and A II, Si II, P III are $2s2p^2$ and $3s3p^2$ with the terms $^4P, ^2DSP$. Recent investigations have shown that, when interpreting the ionization and excitation processes in the solar corona, in the chromosphere, and in nonstationary star envelopes, it is necessary to know the structure of the spectrum occuring at transitions between the sp^2 terms, as well as at transitions from these terms to the basic term s^2p^2p. To this end, an investigation of quadrupole transitions was initiated for the purpose of studying forbidden lines linked with the configurations sp^2 for the elements B I, C II, N III, . . ., and A II, Si II, P III. I.v.L.

N64-26869 California U., Los Angeles
[ANALYSIS OF THE ORGANIC AND INORGANIC CONSTITUENTS OF CARBONACEOUS AND OTHER SELECTED STONY METEORITES] Semi-annual Progress Report, Nov. 1, 1963–May 1, 1964

Harold C. Urey and Bartholomew Nagy [1964] 5 p refs
(Grant NsG-541) OTS: $1.10 ph

The carbonaceous meteorite research consisted of three main lines of approach—study of the chemical composition and optical activity of the saponifiable organic matter isolated from the Orgueil meteorite, investigation of Orgueil meteorite microstructures (organized elements), and mineralogical and petrographic study of the Orgueil meteorite. Author

N64-26928* Consultants and Designers, Inc., Arlington, Va.
A MORPHOLOGICAL PROPERTY OF SUNSPOT GROUPS RESPONSIBLE FOR FLARES ATTENDED BY EMISSIONS IN METER WAVES [UNE PROPRIETE MORPHOLOGIQUE DES GROUPES DE TACHES SOLAIRES RESPONSABLES DES ERUPTIONS ACCOMPAGNEES D'EMISSIONS EN ONDES METRIQUES]
Constantin Caroubalos and Marie-Josephe Martres 15 Jul. 1964 6 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci., Phys. Solaire (Paris), v. 258, 20 Jan. 1964 p 830–832
(Contract NAS5-2078)
(NASA-TT-F-8925; ST-SP-10172)

A geometrical parameter is defined, characterizing the sunspot groups. Flares, attended by meter wave emissions and high-energy particle ejection, form in groups where this parameter is very small. Author

N64-26933 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE MOON UNDER KLIEGLIGHTS
Herbert Pfaffe 4 May 1964 5 p Transl. into ENGLISH from Berliner Zeitung (E. Berlin), 5 Apr. 1963 p 5
(FTD-TT-64-336/1; AD-600508)

A method for moon observation based on the use of laser optics is presented. It provides for the generation of short, very-high-energy light pulses directed toward the moon. With this technique, regions of the moon can be irradiated with artificial light in the visible spectral range, so that this "spotlight-type" illumination can be seen from the earth. This new method makes possible the success of future manned lunar landing because of the added knowledge of the composition of the moon's surface. A.L.B.

N64-26945 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
PROJECT APEQS: SOLAR ECLIPSE FLIGHT EXPEDITION. THE NATIONAL GEOGRAPHIC SOCIETY—DOUGLAS AIRCRAFT COMPANY
W. B. Klemperer Sep. 1963 137 p refs The Expedition was Undertaken Jointly by the Natl. Geograph. Soc. and Douglas Aircraft Co.
(G-36439)

This report describes the solar eclipse flight expedition known as Project APEQS—Airborne Photography of the Eclipse of the Quiet Sun. This expedition gave a large group of astronomers an opportunity to observe and record various phenomena during the total eclipse of the sun on July 20, 1963, from a stratosphere vantage point over the Northwest Territories of Canada. The history of the events leading to the project is briefly sketched. The preparations and modifications of the DC-8 airplane are outlined, and the special installations of astronomical instruments are described and illustrated in detail. The navigational planning is discussed, and an account of the flight operations is given. These comprise the preparatory tests, a dry run on the day before the eclipse, and the eclipse flight proper. A brief summary of the results achieved is presented, pending a scientific evaluation of the results of the 20 experiments conducted during the eclipse. These scientific results will be the subject of individual reports by the experimenters. Author

06 AUXILIARY SYSTEMS

Includes fuel cells and solar cells; gas turbines; hydraulic, pneumatic and electrical control systems and actuators; and inverters. *For primary propulsion systems see*: 27 Propulsion. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-25861 Florida U., Gainesville Engineering and Industrial Experiment Station
FUEL CELLS Quarterly Progress Report, 1 Apr.–Jun. 30, 1963
Robert D. Walker, Jr. 12 Aug. 1963 23 p refs
(Contract DA-49-186-AMC-45(X))
(UFGG-8; AD-435878)

Mass transfer in solid metal electrodes was studied intensively with a view to defining the total transfer process so as to permit a reasonably accurate calculation of the resistances to mass transfer of the several steps. A model for the transfer process is presented, and the several steps are discussed. Methods of measuring gas solubility and diffusivity in fuel cell electrolytes are discussed and the results of preliminary measurements presented. Author

N64-25901* Monsanto Research Corp., Everett, Mass. Boston Lab.
STUDY OF FUEL CELLS USING STORABLE ROCKET PROPELLANTS Final Report, 28 Jun. 1963–27 Jan. 1964
J. O. Smith, R. E. Chute, R. G. Gentile, D. L. Kavanagh, E. A. Mc Elhill et al 11 May 1964 160 p refs
(Contract NAS3-2791)
(NASA-CR-54116; MRB-5002F) OTS: $11.50 ph

A feasibility study of hydrazine-type fuels and dinitrogen tetroxide (N_2O_4) or chlorine trifluoride (ClF_3) oxidants for use in fuel cells is discussed. Theoretical studies were made of the thermodynamic properties of the fuel cell systems under study. The potentials and energy density for the most probable reactions were calculated. The heat absorbed or evolved during the reversible operation of a fuel cell was calculated. The data obtained are used as a basis for defining the theoretical performance of the various proposed systems. P.V.E.

N64-25902* Monsanto Research Corp., Everett, Mass. Boston Lab.
STUDY OF FUEL CELLS USING STORABLE ROCKET PROPELLANTS Quarterly Progress Report No. 1, 28 Jan. – 27 Apr. 1964
J. C. Orth, R. E. Chute, S. Matsuda, W. H. Power, J. O. Smith et al 20 May 1964 66 p refs
(Contract NAS3-4175)
(NASA-CR-54117; MRB-5007Q1) OTS: $6.60 ph

This report describes a systematic study of the solid palladium diffusion electrode, including pretreatments (heat treatment and catalyst deposition) that are required for using the palladium foil for transporting and anodically oxidizing hydrogen. The use of hydrazine as a fuel for supplying hydrogen to the palladium foil anode is also described. The use

of a porous Teflon diffusion electrode for the anodic oxidation of hydrogen or hydrazine and also for the cathodic reduction of oxygen and hydrogen peroxide is described. Such electrodes are combined for initial construction and demonstration of full-cell systems. Construction details for a full cell with 3- by 3-in. electrodes are described. Polarization data are given for the anodic oxidation of hydrogen and hydrazine at flow-through electrodes and solid palladium foils in the anhydrous hydrogen fluoride system. Author

N64-25903* General Electric Co., Cincinnati, Ohio Missile and Space Div.
ELECTROMAGNETIC ALKALI METAL PUMP RESEARCH PROGRAM Quarterly Progress Report No. 3, 27 Dec. 1963–27 Mar. 1964
J. P. Verkamp, ed. 22 May 1964 129 p refs
(Contract NAS3-2543)
(NASA-CR-54036) OTS: $10.10 ph

The objectives of this phase of the program are to determine the feasibility of using electromagnetic (EM) pumps in space electric powerplants, to establish the bases for selecting pumps for specific applications, and the bases for the design of EM pumps applicable to space powerplants, to select pumps for construction and testing, and to establish a test program for the selected pumps. The present status indicates that the new design approach being developed will produce pumps with about one-tenth the weight of previous pumps, and that a boiler feed EM pump for the turboelectric powerplant could be competitive in weight with a canned motor–jet injector pump for the same application. Also, a single-phase induction pump was developed that is particularly well suited to high-temperature primary coolant application. I.v.L.

N64-25918* Westinghouse Electric Corp., Lima, Ohio Aerospace Electrical Div.
SPACE ELECTRIC POWER SYSTEMS STUDY; D-C TO D-C CONVERTERS FOR NUCLEAR THERMIONIC ENERGY SOURCES, VOL. 5 Final Report, 3 May 1963–3 Dec. 1963
A. R. Baker, D. L. Bowles, G. E. Gerecke, E. L. Ingalls, J. W. Ogden et al [1963] 228 p refs OTS: $15.00 ph
(Contract NAS5-1234)
(NASA-CR-55800; WAED-63-11E)

This volume presents the results of an investigation of megawatt d.c. to d.c. converters to be used with space ion thrustor electric propulsion systems when operating from a nuclear-thermionic energy source. Guidelines were established to give direction to the program effort. A preliminary design was made to identify the functional blocks that are common to all the converters considered. Based on the preliminary design, a parametric investigation was made for each functional block at several different power levels and input voltages. The results of the parametric investigations are presented in a report for each functional block. The results include parametric data in tabulated and graphic form, identification of problem areas, analysis and recommendations. A weight, volume, and efficiency summary is given. An analysis of the voltage transients caused by arcing faults in electric engines is presented. Author

N64-25963 Martin Co., Baltimore, Md. Space Systems Div.
AGE REVERIFICATION PLAN—VTF, LV-26BC
R. L. Schlechter May 1964 20 p refs

The tests to be performed in the Aerospace Ground Equipment (AGE) system verification are described. The tests to be performed are those that confirm the logic circuits of the AGE. The system wiring has been proven by the initial performance of the GSTP (Ground System Test Procedures) by Retrofit Test Procedures (RTPs). In this report each control point is identified along with the prerequisites for test; the tests to be performed; and the documentation in which the details of the test can be found. R.T.K.

N64-26058 Joint Publications Research Service, Washington, D.C.
AUTOMATION OF CONTINUOUS FURNACES
S. A. Malyy 30 Jun. 1964 38 p
(JPRS-25288; TT-64-31579) OTS: $1.00

Systems for automatic regulation of the temperature and fuel ratio in metal working furnaces are discussed. Also discussed are systems for the automatic regulation of the preheating of the combustion elements and the protection of the recovery unit. A system for automatic control of these processes and its operation is described. P.V.E.

N64-26069 Canadian Armament Research and Development Establishment, Valcartier
THE INSTRUMENTATION SYSTEM OF CARDE BLACK BRANT ROCKETS CC II–17 AND 18
Leonard Gosselin Jan. 1964 21 p
(CARDE-TN-1611/64)

The object of this report is to record practical information regarding the instrumentation system used in the propulsion Test Vehicles CC II 17 and 18. The specifications and the location of the transducers, the telemetry system, and the power sources are discussed. A list of the main drawings and self-explanatory photographs are included. Author

N64-26163 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PROBLEM OF THERMIONIC CONVERSION OF HEAT INTO ELECTRICITY
Jaroslav Kramar 4 Jun. 1964 19 p refs Transl. into ENGLISH from Elektrotechnicky Obzor (Czechoslovakia), v. 52, no. 10, 1963 p 513–518
(FTD-TT-64-528/1+2; AD-442441)

Problems inherent in the principle of thermoelectric conversion include the characteristic magnetic-field effect, the space-charge effect, and generation of alternating voltage. The discussion of construction and technological problems covers estimation of the service life of an emitter and its vacuum tightness. It is concluded that the emitter-to-collector distance should be lessened; a.c. generators are much better suited for light duty; and lanthanum boride cathodes may be best for long service life. D.E.W.

N64-26202 Frankford Arsenal, Philadelphia, Pa.
DEVELOPMENT OF ELECTRICALLY INITIATED ESCAPE SYSTEM COMPONENTS: IGNITION ELEMENTS T14E2, T19E1, T14E3, T19E2, XM21, XM22, AND XM42; PULSE GENERATORS XM10, XM11, AND XM15
Alonzo E. White Wright-Patterson AFB, Ohio, SEG, Jun. 1964 89 p refs
(Contract AF 33(600)-0-1375A-190)
(FA-R-1725; SEG-TDR-64-28; AD-602763)

A series was developed of electric ignition elements that, when supplied with sufficient electrical energy, are capable of initiating cartridges or mechanisms designed for use in propellant actuated escape systems. Pulse generators, capable of providing the electrical energy necessary to fire these ignition elements, were developed for use as an auxiliary power source. The main advantages of the electrically initiated escape

systems over the existing gas systems are considerable reduction in size and weight in the system for transmission of actuating energy, faster operating times, and providing a means for system continuity checkout. The development and testing of ignition elements T14E2, T19E1, XM21, XM22, and XM42, and the test procedures, data design, and performance characteristics of pulse generators XM10, XM11, and XM15 are presented. The ignition elements and pulse generators functioned reliably within the proposed military requirements. Author

N64-26245 General Motors Corp., Anderson, Ind. Delco-Remy Div.
APPLIED RESEARCH INVESTIGATION OF SEALED SILVER-ZINC BATTERIES
J. J. Lander, L. M. Cooke, and P. A. Scardaville Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., 1 Aug. 1964 305 p refs
(Contract AF 33(657)-10643)
(APL-TDR-64-85; AD-603023)

Cycle life studies were made on groups of cells in which the ratio of ZnO to silver was varied from 0.75:1 to 4:1. Maximum cycle life was obtained at the 2:1 ratio. Tests designed to show the effects of life of separator overhang at the tops and around the plate perimeter indicate that a quarter- to a half-inch overhang around the plate perimeter gives the maximum cycle life in this study. Electrolyte quantity tests indicate that both initial capacity and cycle life are improved if a high electrolyte level is provided, but problems result for sealed cell operation. Cells containing various combinations of acrylonitrile-type separations wrapped around negatives do not show any significant improvement in cycle life as compared to control cells. A detailed theoretical study and an experimental study, concerning the possibility of utilization of a neutral salt electrolyte in silver-zinc cells, are presented. The results indicate that no suitable neutral salt electrolyte is satisfactory for cell performance in this application. Neither CdO additions to the negative active material nor provision for double grids in the negative plate construction showed advantages in initial capacity or cycle life. Author

N64-26246 Cook Electric Co., Dayton, Ohio Inland Testing Labs.
ALKALINE BATTERY EVALUATION
W. W. Clark, W. G. Ingling, I. F. Luke, and E. A. Roeger, Jr. Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Jun. 1964 317 p refs
(Contract AF 33(616)-7529)
(APL-TDR-64-76; AD-602676)

The results obtained from the cycle-life performance tests on these four types of cells show that cell cycle-life with shallow discharges is considerably longer than cycle-life at deep discharges and cycle-life is reduced by high and low ambient temperatures. Author

N64-26276 Atlantic Research Corp., Alexandria, Va.
LIGHTNING PROTECTION MEASURES FOR AIRCRAFT FUEL SYSTEMS, PHASE II
Christian C. Bolta, Raymond Friedman, Gary M. Griner, Michael Markels, Jr., Matthew W. Tobriner, et al Washington, FAA, May 1964 197 p refs
(Contract FA-64WA-4955)
(FAA-ADS-18)

Flame propagation and arrester experiments were performed with the use of high-voltage and high-current facilities, and the experiments were repeated in the combustion laboratory, using a drive tube to simulate the lightning effects. Propagation of flame through actual 707-aircraft vent systems containing flammable fuel–air mixtures was demonstrated, and characteristic flame speeds and pressure pulses were measured and duplicated in the laboratory apparatus. The apparatus provided a range of conditions from low flame speeds of 5 ft/sec to speeds of several hundred ft/sec. Flame arresters were designed to quench flames propagating at high speeds through the vent duct, and were tested at two locations in the system. Pressure-drop and flame-holding characteristics of the best arrester were experimentally determined. R.T.K.

N64-26284 National Research Council of Canada, Ottawa
DIVISION OF MECHANICAL ENGINEERING AND THE NATIONAL AERONAUTICAL ESTABLISHMENT Quarterly Bulletin, 1 Jan.–31 Mar. 1964
[1964] 90 p refs
(DME/NAE-1964(1))

Presented are a discussion on the use of passive anti-roll tanks for roll stabilization in ships and a general description of components used in pure fluid systems (amplifiers, passive components, and logic devices). Also included are brief summaries of the current projects under investigation in mechanics, hydrodynamics, aerodynamics, and thermodynamics. P.V.E.

N64-26363* Naval Ammunition Depot Crane, Ind.
LIFE CYCLE TESTS Monthly Progress Report, Period Ending 30 Jun. 1964
13 Jul. 1964 81 p
OTS: $8.10 ph
(NASA Order W-11252-B)
(NASA-CR-58060)

The results of cycling tests on the following cell types are presented: General Electric 3.0 A.H., Gould 3.5 A.H., Sonotone 5.0 A.H., General Electric 12 A.H. Goulton 6.0 A.H., Gould 20 A.H., and Gulton 20 A.H. The results of cell-failure analysis and capacity tests are included. R.T.K.

N64-26371* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THERMIONIC AND THERMOELECTRIC ENERGY CONVERSION. LITERATURE SEARCH No. 575
9 Mar. 1964 251 p refs
(Sponsored By NASA)
(NASA-CR-58125) OTS: $16.50 ph

The following are included in this document: (1) general—annotated bibliographies; general article reviews and books; conferences; theory and apparatus and measurement techniques; (2) materials—thermoelectric and thermionic properties; (3) power generation—thermoelectric and thermionic converters; and miscellaneous thermal energy conversion devices; and (4) thermoelectric cooling. R.T.K.

N64-26415* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLASHING-BEACON EXPERIMENT FOR MERCURY-ATLAS 9 (MA-9) MISSION
Charles C. Laney, Jr. Washington, NASA, Aug. 1964 32 p refs
(NASA-TN-D-2377) OTS: $0.75

The beacon is designed to produce light pulses at the rate of 1 per second, which at a distance of 10 statute miles (8.7 international nautical miles) visually appear as bright as a second-magnitude star; it is capable of surviving the vibration conditions of the MA-9 launch and of operating at an altitude of 100 nmi for at least 5 hrs. Author

N64-26522 Atomics International, Canoga Park, Calif.
THERMAL TESTING OF THE SNAP 10A PROTOTYPE SYSTEM (PSM-3)
W. F. Marten and J. H. Van Osdol [1964] 111 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9280) OTS: $2.25

The PSM-3 is a nonnuclear system prototype, a full-scale mockup of the Snap 10A configuration in which the sodium–potassium eutectic was circulated at design-level temperatures, and in which the overall system performance was evaluated. All thermal and hydraulic operating conditions that a Snap 10A would experience from launch checkout to orbital operation were simulated within the capabilities of the test facility and system prototype. This report defines the test vehicle and facilities, describes the tests and their objectives, and presents an evaluation of the test results. D.S.G.

N64-26542* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A MEDIUM-DATA-RATE DIGITAL TELEMETRY SYSTEM
Marjorie R. Townsend, Paul M. Feinberg, and John G. Lesko, Jr. Washington, NASA, Jun. 1964 14 p
(NASA TN D-2315) OTS: $0.50

Earth-orbiting satellites require onboard data storage. A suitable medium-data-rate digital telemetry system with 10^7-bit storage is described. Since this storage is provided by a tape recorder, a unique technique for wow and flutter compensation was developed. Hardware applicable to the radiation experiments on the Tiros and Nimbus meteorological satellites was built and is currently being tested. Author

N64-26581* Thompson Ramo Wooldridge, Inc., Cleveland, Ohio Electromechanical Div.
DEVELOPMENT OF A HELIOTROPIC ORIENTATION DEVICE FOR HIGH CONCENTRATION RATIO SOLAR TOWER GENERATION SYSTEMS Quarterly Progress Report, 15 Jan.–15 Apr. 1964
21 Apr. 1964 65 p
(Contract NAS 1588)
(NASA-CR-56410; ER-5906) OTS: $6.60 ph

Research effort has been concentrated in the following areas that are associated with the development of a near-prototype heliotropic mount: (1) the review of the basic considerations and design factors related to the many mount and actuation concepts; (2) a detailed study and selection of a preferred mount-design concept; and (3) the fabrication of all mount hardware, along with the preparation of the test facilities required for a comprehensive mount evaluation. R.T.K.

N64-26588* General Electric Co., Schenectady, N.Y. Advanced Technology Labs.
STUDY OF USE OF AUXILLIARY ELECTRODES IN SILVER CELLS First Quarterly Report, 1 Feb.–1 May 1964
[1964] 12 p
(Contract NAS5-3669)
(NASA-CR-6000) OTS: $1.60 ph

The primary objective of this program is to investigate the use of auxiliary electrodes in primary and secondary silver-zinc cells and to modify commercially available silver-zinc cells for testing. Additional work areas include the continuation and the completion of testing of silver-cadmium cells with auxiliary electrodes, and the investigation of electrochemical techniques for recombining hydrogen evolved from primary silver-zinc cells used in satellite power supply systems. Project work was started during the second week of March. The initial work consisted largely of establishing experimental work plans and fabricating test cells to determine hydrogen and oxygen recombination rates for various auxiliary electrode material compositions and geometry. The silver-cadmium cells from the previous contract were returned to cyclic testing but this was discontinued when it was observed that the capacity of the cells had decreased to less than 25% of their original value. Author

N64-26605 Eagle-Picher Co., Joplin, Mo. Couples Dept.
INVESTIGATIONS LEADING TO THE DESIGN OF A RELIABLE SEALED NICKEL-CADMIUM CELL First Quarterly Progress Report, 1 May–31 Jul. 1963
C. O. Gosch 31 Jul. 1963 44 p
(Contract DA-36-039-AMC-00135(E))
(Rept.-5; AD-437530)

Data accumulated in a study made of the several factors in the design experiment and the response information obtained on charge retention, after a 1-month storage period, were analyzed. The design experiment was delineated, and the response data were detailed for the factors of electrolyte concentration, additives, type of sintered plaque, type of separation, type of negative plate, and type of cell. The results of the analysis of the responses of the cells studied in the experiment before and after a 1-month storage period were recorded, and the influence of the various parameters was shown. Author

N64-26661 Goodyear Aerospace Corp., Akron, Ohio
SOLAR REFLECTOR FOAMING TECHNOLOGY Fifth Quarterly Progress Report No. 5, 1 Nov. 1963–31 Jan. 1964
Wright-Patterson AFB, Ohio, Aero Propulsion Lab., Feb. 1964 21 p refs
(Contract AF 33(657)-10165)
(GER-11494; AD-439605)

Efforts and accomplishments of the Solar Reflector Foaming Technology Program are discussed. There were three general accomplishments: (1) All the support and checking equipment required to rigidize a 10-ft mirror in a vacuum chamber was completed and readied for use. (2) One 10-ft-diameter reflector was fabricated, installed on a test stand, and checked with the contour checking fixture. (3) The physical-property testing program, including the obtaining of data on a 0.75 lb/ft^3 lightweight foam, was completed. P.V.E.

N64-26756 Wissenschaftliche Gesellschaft für Luft- und Raumfahrt, Cologne (W. Germany)
ENERGY TRANSDUCERS AND ELECTRIC PROPULSION Report on the First Meeting of the Technical Committee [ENERGIEWANDLER UND ELEKTRISCHE ANTRIEBE Bericht über die 1. Sitzung des Fachausschusses]
1964, 88 p refs In GERMAN Meeting Held at Stuttgart, 3 May 1963
(WGLR-2/1964) Available from WGLR, Martinstrasse 40/42, Cologne, W. Germany: 25 DM

This report contains the following papers: (1) "Developmental Problems of Thermionic Energy Transducers"; (2) "The Physical Bases of Thermionic Converters and a Survey of Their Practical Application"; (3) "On the Developmental Status of Gas-filled Thermionic Converters"; (4) "Comparative Experiments with Noble Gas Diodes of Various Designs"; (5) "The Radial Temperature Distribution in the Emitters of Plane Thermionic Diodes"; (6) "An Investigation of the Electron Work Function of Single Crystal and Polycrystalline Metal Surfaces"; (7) "The Effect of a CsF Atmosphere on the Electron Emission of Tungsten"; and (8) "On the Ion Microscopic Measurement of Surface Diffusion from Calcium to Tungsten." I.v.L.

N64-26759* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AN ANALOG STUDY OF A ROTATING-SOLID-ROCKET CONTROL SYSTEM AND ITS APPLICATION TO ATTITUDE CONTROL OF A SPACE-VEHICLE UPPER STAGE

A. Thomas Young and Jack E. Harris Washington, NASA, Aug. 1964 63 p refs

(NASA-TN-D-2366) OTS: $1.75

A study of the characteristics of a control system employing rotating-solid-propellant rockets for control forces is presented. An open-loop analysis as well as a closed-loop analysis of the control system is presented. The results of the open-loop analysis are given in the form of a nonlinear mathematical representation of the system's dynamic operation. This mathematical representation is used in the closed-loop study that is a guidance and control analysis of a typical vehicle system. The guidance and control analysis employs a guidance system simulation incorporating various nonlinearities present in the system, a three-dimensional trajectory simulation and six-degree-of-freedom rigid-body vehicle simulation, as well as the derived nonlinear simulation of the control system. The nonlinear characteristics of the control system that significantly affect its performance as observed from the analysis are friction, actuator velocity limit, and a sine function of the control deflection angle. The results of the guidance and control analysis show that gains can be selected from a consideration of dynamic stability, steady-state accuracy, and reliability that would insure a satisfactory flight mission.

Author

N64-26781* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ANALYTICAL INVESTIGATION OF THE RADIATOR AREA CHARACTERISTICS OF OUT-OF-PILE THERMIONIC GAS CYCLE SPACE POWER SYSTEMS

Michael R. Vanco and Arthur J. Glassman Washington, NASA, Aug. 1964 37 p refs

(NASA-TN-D-2429) OTS: $1.00

The radiator area potential of out-of-pile thermionic space power systems using an inert gas as the heat-transfer medium was assessed by studying the radiator area characteristics of three typical cycles and comparing the minimum radiator area requirements with those for a turboelectric Brayton cycle. The three cycles considered were the split radiator, the two loop, and the turbineless cycles. This study was primarily a thermodynamic cycle analysis, with thermionic converter efficiency being treated both parametrically and through the use of experimental data. On the basis of this thermodynamic analysis, no significant difference in radiator area requirements was found among the three out-of-pile thermionic gas cycles. A comparison of radiator area requirements for one of these cycles with those for a turboelectric Brayton cycle showed that either high converter efficiencies or high converter inlet temperatures are necessary if an out-of-pile thermionic gas cycle is to have any radiator area advantage over the Brayton cycle. Converter efficiencies greater than about 0.3 of Carnot or converter inlet temperatures greater than 3,500° R are required to make the out-of-pile thermionic gas cycle appear attractive.

Author

N64-26795 General Motors Corp., Indianapolis, Ind. Engineering Dept.

THEORETICAL ANALYSIS OF SOLAR REFLECTORS

George L. Schrenk 1 Jul. 1963 36 p refs

(Rept.-3193)

This technical report describes the development of a mathematical model of actual solar reflectors. More specifically, it presents the derivations and solution techniques of a set of equations for determining the intensity distribution on any plane perpendicular to the optical axis from any arbitrarily shaped reflector surface. The model described also includes provisions for treating random surface errors on the reflector surface and orientation errors of any size. No approximations were introduced; thus, the model is accurate within the limitations of the numerical techniques of integration on high-speed digital computers.

Author

N64-26796 Atomics International, Canoga Park, Calif.

STRUCTURAL TEST ON THE FINAL SNAP IDA PROTOTYPE SYSTEM (PSM-1A)

H. L. Henley and W. H. Dauterman 15 Jul. 1964 82 p refs

(Contract AT(11-1)-GEN-8)

(NAA-SR-9820) OTS: $1.30

Data obtained from the acoustic tests were in agreement with measured vibration resonances and with general types of responses. However, acoustic test data revealed that the specified acoustical inputs were far less damaging to the basic structure than the vibration inputs. Shock inputs were observed to have little effect on the vehicle strain and/or acceleration response. Static testing, designed to simulate the steady-state acceleration environment, showed similar results. No excessive strains or deflections were observed. A reactor support leg failure occurred during vibration testing due to an inadvertent overload of the structure. Marginal clearance between the shield and reactor leg structure contributed to this failure because, as impact between the legs and the shield occurred, high acceleration spikes caused signal distortion on the control channels that an electonic g-limiting device was not equipped to handle. The reactor leg structure was redesigned and reworked and subsequent qualification tests on the PSM-1A vehicle were conducted without incident. A loosening of some reactor leg fasteners was noted during the vibration program and, while this particular condition was not considered detrimental to the structural integrity of the vehicle, it nevertheless will be corrected on all future systems.

Author

N64-26827 Frankford Arsenal, Philadelphia, Pa.

DEVELOPMENT OF THRUSTER, CARTRIDGE ACTUATED, XM25 Technical Memorandum, Jun. 1962–Feb. 1964

Charles J. Litz, Jr. Jun. 1964 38 p refs

(M64-31-1; AD-442963)

A design study was made to improve the initial lock of the M20 thruster to prevent premature release—resulting from shock and impact—and rotation of the threaded end cap with respect to the outer body. Two designs were prepared, fabricated, and evaluated. The final thruster design was designated Thruster, Cartridge Actuated, XM25. Results of performance firings at —65°, 70°, and 200° F; 6 and 9-foot drop tests; static compression-tension tests; and vibration tests indicate that the XM25 thruster met or exceeded the performance of the M20 thruster. The vibration test fixture was designed to simulate aircraft mounting. It is recommended that the XM25 thruster be standardized and that it replace the M20 thruster.

Author

N64-26828 Army Missile Command, Huntsville, Ala.

THE DEVELOPMENT OF A NONLINEAR CONTROL SYSTEM FOR DIRECTION CONTROLLED ANTITANK CLASS MISSILES

Jesse A. Armstrong and William W. Malcolm 28 May 1964 30 p

(RG-TR-64-2; AD-443588)

Inner-loop, electronic-control system development considerations, from the design concept to checkout philosophy, are given for a direction-controlled, anti-tank class missile. Test results are given for gyro and control-electronics integration, and for static motor test that used electronics and torquer control.

Author

N64-26832 General Motors Corp., Indianapolis, Ind. Allison Div.
IBM 7090 COMPUTER PROGRAM FOR ANALYSIS OF SOLAR REFLECTORS (DECK D70E)
George L. Schrenk 8 Feb. 1963 35 p
(EDR-3666)

This program is a mathematical model for analysis of actual solar reflectors. The model includes provisions for treating random surface errors on the reflector surface and orientation errors of any size. This program is presently designed to treat paraboloidal reflectors, conical Fresnel serrations, spherical Fresnel serrations, and/or any part of these reflectors. This program calculates the intensity distribution on any plane perpendicular to the optical axis of the reflector. It also calculates the fraction of total incident energy collected as a function of radial distance in the same plane. Author

N64-26833 Atomics International, Canoga Park, Calif.
SNAP 10A-PSM-1 TEST RESULTS
R. M. Oliva 15 Jul. 1964 85 p
(Contract AT(11-1)-GEN-8)
(NAA-SR-8399) OTS: $2.00

This report documents the results of the environmental test program that was conducted on the SNAP 10A prototype system mockup, PSM-1 to ascertain the dynamic characteristics of the structural design and to qualify the basic structure for the anticipated launch environment. Included in this report are results of vibration testing in each of three mutually perpendicular axes, acoustic test, and special vibration surveys and tests. Supplemental program activities also included are the highway transportation of a simulated test vehicle, and a sled test program for simulating an acceleration environment. Author

N64-26886 Massachusetts Inst. of Tech., Cambridge
BASIC APPLIED RESEARCH IN FLUID POWER CONTROL Seventh Progress Report, Oct. 1, 1963–Jan. 31, 1964
S. Y. Lee and H. H. Richardson 2 Jun. 1964 135 p refs
(Contract AF 33(657)-7535)
(Rept.-8998-7; FDL-TDR-64-72; AD-603195)

High-performance fluid control devices for advanced aerospace systems are discussed. Continued emphasis is placed on pneumatic components and systems capable of performing over wide ranges of temperature and in the presence of intense radiation. This report describes work with a new pulse actuation system, a pneumatic pulse-length-modulated servo system, a gas-operated accelerometer, the dispersion of transients in fluid transmission lines, a new electrostatic pure fluid jet valve, a dirt-insensitive flapper valve, and gas-lubricated bearings. Author

N64-26931 Pennsylvania State U., University Park Coll. of Mineral Industries
THE SIMPLE-PORE AND THIN-FILM MODELS OF POROUS GAS DIFFUSION ELECTRODES
L. G. Austin, Mario Ariet, Robert D. Walker (Fla. U.), Gwendoline B. Wood, and Raymond H. Comyn (Harry Diamond Labs.)
May 1964 36 p refs
(Contract DA-49-186-502-ORD-917)
(Rept.-7; AD-602276)

Two physical models for the mode of operation of porous gas diffusion electrodes for fuel cells are discussed. For nonwetted electrodes the simple-pore model is proposed, in which reactant gas dissolves in electrolyte and diffuses to the submerged electrode surface near the three-phase boundary of solid–liquid–gas. For normal gas solubilities and diffusion coefficients, this model will lead to low-mass transport limited currents unless the pore diameter is less than about 1μ. For wetted double-layer structure electrodes the thin-film model appears reasonable on the basis of experimental observation. An approximate mathematical treatment of this model leads to useful simple solutions that can form the basis for design of experiments to test the model. Author

N64-26959 Cook Electric Co., Dayton, Ohio Inland Testing Labs.
ALKALINE BATTERY EVALUATION Semi-Annual Report, Apr. 1962–15 Mar. 1964
W. W. Clark, W. G. Ingling, I. F. Luke, and E. A. Roeger, Jr. Wright-Patterson AFB, Ohio. AF Aero Propulsion Lab., May 1964 202 p refs
(Contract AF 33(657)-8450)
(APL-TDR-64-65; AD-602258)

This program includes the cycle-life performance evaluation and failure analysis of sealed, secondary, alkaline cells—two types of 25 amp-hr silver–zinc cells; one type of 15 and one type of 20 amp-hr silver-cadmium cells; and one type of 20 amp-hr nickel–cadmium cell. The program also includes a study of the effects of radiation upon each type of alkaline cell. The extraterrestrial space radiation environment is studied. The expected results of space radiation on alkaline storage cells and cell components are described. The formulation of a radiation test program on alkaline storage cells using the extraterrestrial space radiation environment and the expected results of space radiation are discussed. Author

07 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy); chemical engineering; chemical properties of materials; and synthesis. *For related information see*: 18 Materials, Metallic; 19 Materials, Nonmetallic; and 26 Propellants and Combustion.

N64-25835 Monsanto Research Corp., Dayton, Ohio Dayton Lab.
INVESTIGATION OF FLUORO COMPOUNDS FOR THERMAL PROTECTION Final Summary Report, 19 Apr. 1961–18 Apr. 1963
J. M. Butler and L. E. Erbaugh [1963] 171 p refs
(Contract DA-19-129-QM-1773)
(AD-438520)

The thermal degradation of halo-polymers was studied in relationship to possible processes of thermal protection. The kinetics and energetics of the thermal degradation of polyethylene, polyvinyl fluoride, polyvinylidene fluoride, polyvinyltrifluoroethylene, polytetrafluoroethylene, polyvinyl chloride, and polyvinylidene chlorofluoride, were investigated by thermogravimetric analysis (TGA) and differential thermal analysis (DTA). Energy absorption by endothermic decomposition is not a major factor in the thermal protection afforded by these polymers, nor does endothermic decomposition account for the differences in thermal protection shown by the different polymers. Theoretical and experimental studies were made to relate smoke formation to thermal protection. The results support, but do not prove, the hypothesis that attenuation by smoke from the decomposition of a material is a significant factor in the protection afforded against high-intensity thermal radiation. Author

N64-25840 Bureau of Mines, Tuscaloosa, Ala. Tuscaloosa Metallurgy Research Center

SELECTIVE FLOTATION OF A BARITE-FLUORSPAR ORE FROM TENNESSEE

W. H. Eddy and James S. Browning 1964 12 p refs
(BM-RI-6491)

Laboratory batch and small-scale continuous flotation tests were conducted on a ferruginous barite–fluorspar ore to determine the feasibility of producing commercial-grade fluorspar and barite concentrates. The lignin sulfonate–sodium fluoride–fatty acid method of floating fluorspar produced acid-grade concentrates. Flotation of the barite from the fluorspar tailing using petroleum sulfonate yielded concentrates suitable for use as a weighting agent in oil-well drilling muds. The continuous flotation tests, treating about 150 pounds of ore per hour, yielded fluorspar concentrates that assayed 98.3% CaF_2 and barite concentrates that assayed 91.2% $BaSO_4$. The recovery of the two minerals was 91.2% and 85.2%, respectively. Author

N64-25841 Bureau of Mines, Berkeley, Calif. Berkeley Thermodynamics Lab.

HEATS AND FREE ENERGIES OF FORMATION OF SULFIDES OF MANGANESE, IRON, ZINC, AND CADMIUM

L. H. Adami and E. G. King 1964 14 p refs
(BM-RI-6495)

The heats of formation of four sulfides—MnS (alabandite), FeS (hexagonal pyrrhotite), ZnS (wurtzite), and CdS (greenockite)—were determined by hydrochloric acid solution calorimetry. The heats of formation from the metals and rhombic sulfur at 298.15° K are, respectively, -51.01 ± 0.19, -23.81 ± 0.24, -45.86 ± 0.20, and -35.70 ± 0.30 kcal/mole. The corresponding free energies of formation were calculated from the heats of formation and the pertinent entropy values. Author

N64-25855 Lockheed Missiles and Space Co., Palo Alto, Calif. Materials Sciences Lab.

LITHIUM-SILVER CHLORIDE SECONDARY BATTERY INVESTIGATION

J. E. Chilton, Jr., W. J. Conner, and R. W. Holsinger 14 Apr. 1964 37 p refs
(Contract AF 33(615)-1195)
(QPR-1; AD-439399)

An aluminum case cell design was considered that will enable sealed cells to be readily fabricated. The design incorporates fluorocarbon-elastomer terminal and fill plug seals with an arc-welded bottom closure to prevent cell leakage and atmospheric contamination of electrode materials and electrolyte. Measurements of electrode polarization indicate the order of limiting currents for electrode reactions on charge and discharge modes of cell operation. Silver chloride utilization in typical silver mixes may range from 10% to 42%. Improvement in utilization was found by changing the type of the ingredients and increasing the volume of electronic conductors added to the electrode mix. The analysis of electrodeposited lithium indicates that less than 0.5 mole percent of the deposit is aluminum. Electrodeposited lithium utilization measured by cathodic formation and subsequent anodic oxidation is strongly dependent on current density. Cell heat measurements yield thermodynamic values for the postulated cell reaction of free energy, heat of reaction, and entropy that are within experimental accuracy equal to the theoretical values calculated for the following cell reaction with cell reactants and products in solid state: $Li + AgCl \rightarrow LiCl + Ag$. Author

N64-25858* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

COMBUSTION–CONDUCTOMETRIC DETERMINATION OF LESS THAN 10 p.p.m. CARBON IN TUNGSTEN

William A. Gordon, Judson W. Graab, and Zita T. Tumney Repr. from Anal. Chem., v. 36, Jun. 1964 p 1396–1398 refs
(NASA-RP-232)

A method is presented for the accurate determination of carbon in tungsten. Experiments were also run to find limitations on accuracy imposed by a variety of typical additives. Procedures and conditions are minutely described. D.E.W.

N64-25865 Union Carbide Nuclear Co., Oak Ridge, Tenn. Nuclear Div.

X-RAY FLUORESCENCE TABLES: PROGRAM DESCRIPTION

W. P. Amsbury, W. W. Lee, J. H. Rowan, and G. E. Walden 20 Jul. 1964 36 p
(Contract W-7405-ENG-26)
(Y-1470-A) OTS: $1.00

A critical compilation of standard reference tables of X-ray fluorescence lines has been published in convenient form for experimental use. This section of the report describes the computer programs that were used to generate the tables, and provides the information necessary to generate tables for any other particular analyzing crystal. Author

N64-25895 Oregon State U., Corvallis

Z CENTER ENERGY LEVELS

Wilbur V. Johnson and Allen B. Scott 20 May 1963 8 p refs
(Contract Nonr-1286(05))
(ONR-TR-7; AD-600617)

Alkali halide crystals containing added alkaline earth cations and colored by excess electrons exhibit, under certain conditions, absorption bands called the Z-bands. Various models have been proposed to account for these Z-bands. The electronic energy levels of one of the simplest of these models, an unassociated alkaline earth cation with one trapped electron, are calculated. The problem is treated as a one-electron problem, and the solution is estimated by using one-parameter hydrogen-like trial wave functions in a variational procedure. The impurity cation is treated as a substitutional distributed charge, the distribution being determined from the statistical procedure of Thomas and Fermi. The host lattice is considered to be an essentially continuous dielectric medium, the only discontinuity being the spherical cavity in which the divalent cation is placed. The computations were carried out for Ca^{+2} and Sr^{+2}, both in NaCl and KCl. P.V.E.

N64-25978 Hanford Atomic Products Operation, Richland, Wash.

SOLVENT EXTRACTION OF STRONTIUM, CERIUM AND RARE EARTHS WITH D2EHPA. PART I: LABORATORY STUDIES

W. W. Schulz Feb. 1964 58 p refs
(Contract AT(45-1)-1350)
(HW-79762, Pt. 1) OTS: $1.50

A solvent extraction process for separating strontium and rare earths from Purex process acid waste was developed. The extractant is di-(2-ethylhexyl) phosphoric acid (D2EHPA) dissolved in a tributyl phosphate and hydrocarbon diluent. There are two product streams—one contains the strontium and the other contains the rare earths. Author

N64-26021 McMaster U., Hamilton (Canada)
INHIBITED DISSOLUTION OF [100] SURFACES OF SINGLE CRYSTALS OF LITHIUM FLUORIDE
M. B. Ives and J. T. Plewes May 1964 16 p refs
(Contract Nonr-3925(00))
(TR-2; AD-600328)

A technique is described for the determination of the dissolution rates of lithium fluoride surfaces in dilute aqueous solutions of ferric fluoride. The effect of ferric ion content of the etchant on the rate is constant for ion concentrations substantially in excess of the optimum for the production of smooth-faced square etch pits at dislocations. The results correlate well with recent theories concerning the adsorption of ferric ions during etching. The effect of lithium fluoride undersaturation varies greatly from specimen to specimen and demonstrates the heterogeneous nature of hole nucleation in the close packed surfaces. Author

N64-26075* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.
INTENSITIES OF 9.4 μ AND 10.4 μ CO_2 BANDS
S. I. Rasool Repr. from Memoires Soc. R. Sc. Liege, Ser. 5, v. 9 [1963] p 55–57 refs
(NASA-RP-253)

The intensities of the 9.4μ and 10.4μ CO_2 bands were computed theoretically using, as the basis of calculation, the line profiles at the centers of these bands published by Migeotte, Neven, and Swensson (1957). The band intensity values obtained were as follows: 9.4μ band—0.0180 cm^{-2}-atm^{-1} at 265° K and 10.4μ band—0.0098 cm^{-2}-atm^{-1} at 265° K. The ratio of the two band intensities is 1.84, which is closer to the value of 1.7 given by Kostkowski (1955) than to 2.4 reported by Penner (1959). I.v.L.

N64-26077* California U., Santa Barbara
ULTRAVIOLET OPTICAL PROPERTIES OF DIAMOND
W. C. Walker and J. Osantowski Repr. from the Phys. Review, v. 134, no. 1A, Apr. 1964 p A153–A157 refs
(Sponsored by NASA)
(NASA-RP-256)

Measurement was made of the absolute reflection spectrum of type IIa diamond at room temperature from 4 to 30 ev and analyzed by dispersion techniques to obtain the optical parameters. Structure observed in the dielectric constant near 7, 12, 16, 20, and 24 ev was attributed to interband transitions at critical points in the joint density-of-states function. The new high-energy structure near 16, 20, and 24 ev was assigned to transitions near the L point of the Brillouin zone. Experimental interband transition energies are compared to band-theory calculations. IAA

N64-26082* Arizona U., Tucson
WINDOWLESS X-RAY TUBE SPECTROMETER FOR LIGHT ELEMENT ANALYSIS
Ralph W. G. Wyckoff and Franklin D. Davidson Repr. from the Review of Sci. Instr., v. 35, no. 3, Mar. 1964 p 381–383 refs
(Grant NsG-120; NIH-G-DE-01183; NSF-G-9760)

A windowless tube spectrometer is described for the X-ray fluorescent analysis of the light elements down through fluorine. The high efficiency of X-ray excitation makes possible the analysis of elements as light as sodium when present in less than 1% and of fluorine in larger amounts. Author

N64-26100 European Atomic Energy Community, Brussels (Belgium)
SOME ANALYTICAL APPLICATIONS OF THE INTENSITY RATIO OF COHERENT TO INCOHERENT SCATTERING IN X-RAY SPECTROSCOPY [QUELQUES APPLICATIONS ANALYTIQUES DE LA DIFFUSION COHERENTE ET INCOHERENTE DES RAYONS X]
C. J. Toussaint and G. Vos Joint Nucl. Res. Center, ISPRA Estab. (ITALY), Mar. 1964 30 p refs In FRENCH; ENGLISH Summary Presented at the XI Colloq. Spectroscopicum Intern., Belgrad, 30 Sep.–4 Oct. 1963
(EUR-488.F) Available from Belgian Am. Bank. and Trust Co., N.Y., Account No. 121.86; 50 Belg. Fr.

The method proposed by Dwiggins for the determination of C/H report in organic liquids by measuring the report of coherent and incoherent diffusion may be generalized, especially by using other radiations than $L\alpha_1 W$. Some applications are described as the determination of the C/H report in polyphenyls and the analysis of binary and ternary mixtures. Author

N64-26119 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON THE CHEMICOKINETIC BASIS FOR THE DIFFERENCE BETWEEN PRIMARY AND SECONDARY EXPLOSIVES
K. K. Andreyev and M. S. Plyasunov 16 Jun. 1964 6 p refs Transl. into ENGLISH from Zh. Uses. Khim. Obshchestva Im D. I. Mendeleyeva (USSR), v. 8, no. 5, 1963 p 586–587
(FTD-TT-64-328/1; AD-602339)

Compositions are given of the gaseous products of the constant pressure combustion of 13 different explosives. The temperatures of combustion at constant standard pressure are presented. The constant pressure stipulation in the calculations is shown to be a limitation on the validity of comparison by products. Instead, comparison by heat flow from the combustion surface is suggested as a better method of choosing an explosive that is both powerful and insensitive. D.E.W.

N64-26184 University Coll. of Wales, Aberystwyth (Gt. Brit.) Edward Davies Chemical Lab.
MOLECULAR PARAMETERS AND BOND STRUCTURE, PART 2: CARBON–HYDROGEN BONDS IN CH_3X AND CH_2XY MOLECULES Scientific Report No. 8
R. G. Jones, J. A. Ladd, and W. J. Orville-Thomas 9 Apr. 1964 21 p refs
(Contract AF 61(052)-691)
(AFCRL-64-486; AD-602652)

Carbon–hydrogen bond-stretching vibrations do not interact appreciably with other modes; their frequencies give information on bond structure. An infinite number of possible electronic structures for a bond of definite strength is theoretically possible. Author

N64-26205 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Environmental Sciences Directorate
THE COLOR IDENTIFICATION OF TRANSPARENT CRYSTALLINE PARTICLES WITH AN OPTICAL MICROSCOPE. A LITERATURE SURVEY OF DISPERSION STAINING
Glenn B. Hoidale Jul. 1964 22 p refs
(ERDA-165; AD-603019)

This brief survey is intended to present an introduction to the various ways to achieve dispersion staining colors by microscopy, with particular application to atmospheric mineral dust identification. The evolution of dispersion staining

as a means for identifying small mineral particles is traced from 1872 to date. An example of how color arises is shown schematically, and guidelines are presented for the choice of a microscope system and immersion fluids. Author

N64-26213 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THIRD INTERINSTITUTIONAL SCIENTIFIC CONFERENCE ON PROBLEMS OF EVAPORATION, COMBUSTION AND GAS DYNAMICS OF DISPERSION SYSTEMS
O. I. Polishchuk 8 Jan. 1964 8 p Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 8, no. 4, 1963 p 498–500
(FTD-TT-63-944/1; AD-430370)

Informal discussions of papers presented at the conference are reported. In the gas dynamics papers, maximum interest was aroused by the report by Kamov, "Experimental Investigations of the Flow of a Two Phase Mixture in an Axially Symmetric Nozzle." Titles for other papers and notes concerning them are also given. D.E.W.

N64-26242 Ohio State U. Research Foundation, Columbus
A STUDY OF THE TEMPERATURE DEPENDENCE OF THE TOTAL ABSORPTANCE OF CO NEAR 4.7mu and 2.3mu and CH_4 NEAR 3.3mu Scientific Report No. 5
Dennis Vanderwerf May 1964 84 p refs
(Contract AF 19(604)-6141)
(AFCRL-64-448; AD-442926)

The dependence of the total absorptance of the bands of carbon monoxide near 4.7μ and 2.3μ, and of methane near 3.3μ, on absorber concentration, pressure, and temperature was measured. Data were taken for absorber pressures between 100- and 1,000-mm Hg, and at temperatures up to 400° C, for a fixed absorber path length of 30.6 cm. The nature and possible reasons for the observed temperature dependence of the total absorptance are discussed. Author

N64-26256 Joint Publications Research Service, Washington, D.C.
CERTAIN PENTAVALENT CHROMIUM COMPLEXES AS INVESTIGATED BY MEANS OF ELECTRON-SPIN RESONANCE
N. S. Garif'yanov 29 Jun. 1964 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 155, no. 2 p 385–388
(JPRS-25281; TT-64-31574) OTS: $0.50

In the present work, the electron-spin resonance method was used to study liquid and ultracool solutions of oxyfluoride, oxychloride, and oxysulphate of tentavalent chromium. Measurements were made with a standard radiospectroscope RE-1301 under temperatures of 295°, 280°, 240°, and 77° K at a frequency of 9,320 megaherzs. The concentration of pentavalent chromium in solutions was determined by comparison of the electron-spin resonance line to the free radical DPFG. The width of the line was designated as the distance in oersteds between the maximum and minimum of the primary resonance curve. Author

N64-26299 Joint Publications Research Service, Washington, D.C.
BIBLIOGRAPHY OF WORKS BY SCIENTIFIC PERSONNEL OF THE "I. V. GREBENSHCHIKOV" INSTITUTE OF SILICATE CHEMISTRY, ACADEMY OF SCIENCES USSR, 1948–1961
Z. P. Galunova et al 11 Jun. 1964 199 p refs Transl. into ENGLISH from the Book "Bibliograficheskiy Ukazatel' Rabot Nauchnykh Sotrudnikov Instituta Khimii Silikatov Im. I. V. Grebenshchikova Akademii Nauk SSSR 1948–1961 GG. , 1963 169 p
(JPRS-25037; OTS-64-31457) OTS: $3.00

N64-26307 Pennsylvania State U., University Park Mineral Industries Experiment Station
THE KINETICS OF A REDOX REACTION AT SOLID AND POROUS ELECTRODES
Harry Lerner (Ph.D. Thesis) and L. G. Austin May 1964 204 p refs
(Contract DA-49-186-502-ORD-917)
(Rept.-6; AD-603044)

Verifying the theory of polarization for a porous diffusion electrode system was the purpose of this report. In addition, all of the theory and recent literature that is relevant to the problem is presented in considerable detail. The two most significant findings of the study, using the $SnCl_2$, $SnCl_4$ redox couple at solid and porous electrodes of carbon, are that there is a doubling of the normal Tafel slope for the porous electrode systems, and that the calculated and experimental Tafel intercepts for the porous electrode systems are in good agreement. The proposed theory for the porous diffusion electrode system is correct. This has significance from a fundamental point of view since it confirms, for the first time, the proposed physical picture of this type of system. It also has practical implications in the field of fuel cells and related energy conversion devices where such systems are often used but not well understood. In particular, it justifies the extension of the concepts used to the more complex gas diffusion type of electrode system. Author

N64-26308 General Electric Co., Schenectady N.Y. Research Lab.
RESEARCH OF DIELECTRIC MATERIALS Technical Report, Jan. 15, 1963–Jan. 15, 1964
J. C. Devins, H. L. Greenhaus, R. J. Wolff, D. R. Johnston, F. F. Carini et al Wright-Patterson AFB, Ohio, AF Mater. Lab, May 1964 135 p refs
(Contract AF 33(657)-8825)
(ML-TDR-64-57; AD-602437)

This report is concerned with electron impact ionization and attachment in polyatomic gases. These processes were examined with a mass spectrometer operating with a retarding potential difference electron source. In the second section, ionization and attachment coefficients were measured with an electron swarm, or Townsend technique. Results were obtained principally with perfluorocarbon gases, many of which are of interest for use as high dielectric strength gases. Studies of the chemical degradation of materials under the action of corona were continued; besides continuing studies on weight loss in Mylar, similar investigations were made on "H" film. The chemical effects of different types of corona discharges, distinguished during our first contract, were studied on model compounds. By the use of d. c. voltages, it was possible to compare damage caused by positive ion and electron bombardment. Author

N64-26320 Cincinnati U., Ohio
THE INFRARED SPECTRA OF POLYMERS, RESINS, AND RELATED MATERIALS IN THE 700–250 cm^{-1} REGION AND THEIR ANALYTICAL APPLICATION
Dieter O. Hummel Wright-Patterson AFB, Ohio, AF Materials Lab., Apr. 1964 354 p refs
(Contract 33(616)-7450)
(ASD-TDR-63-712; AD-600552)

The infrared absorption spectra of 191 polymers, resins, waxes, plasticizers, monomers, and solvents were investigated from 700 cm^{-1} to 250 cm^{-1}. The absorption bands of the more important chemical families were incorporated into correlation charts. The structures of the substances investigated are discussed with respect to their infrared spectra. Author

N64-26322 National Academy of Sciences–National Research Council, Washington, D.C. Prevention of Deterioration Center
EFFECT OF MICROORGANISMS ON NATURAL AND SYNTHETIC RUBBERS Bibliography
Hans Janecka, comp. 2 Dec. 1963 12 p refs
(PDL-50015; AD-600644)

N64-26325* Georgia Inst. of Tech., Atlanta
CHEMICAL REACTIVITY AND SYNTHESIS AT CRYOGENIC TEMPERATURES
H. A. Mc Gee, Jr. Repr. from Advan. Cryog. Eng., v. 9, 1964 11 p refs Presented at 1963 Cryog. Eng. Conf., Boulder, Colo., 19–21 Aug. 1963
(Grant NsG-123-61)

A history of the development of techniques for studying chemical synthesis at cryogenic temperatures is presented. The technology used and the results obtained in recent studies in low-temperature chemistry is given, and the potentiality of cryochemistry is stressed. R.T.K.

N64-26356* Aerojet-General Corp., Azusa, Calif. Von Karman Center
RESEARCH ON PROCESSES FOR UTILIZATION OF LUNAR RESOURCES Quarterly Report, 1 Mar.–31 May 1964
S. D. Rosenberg, G. A. Guter, and F. E. Miller Jun. 1964 35 p ref
(Contract NAS7-225)
(NASA-CR-56885; Rept.-0765-02-2) OTS: $3.60

Several runs were made reacting natural silicates with methane, methane–hydrogen mixtures, carbon, and silicon carbide. Reduction occurred with the production of carbon monoxide, metal, and slag. The carbon oxides produced account for 90% of the carbon entering the reaction. Refinements were made in reactor and inlet tube design. Author

N64-26398 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 98
21 Jul. 1964 15 p refs Transl. into ENGLISH from Hua-Hsueh Tiung-Pao (Peiping), no. 5, May 1964 p 53–57
(JPRS-25530; TT-64-31802) OTS: $0.50

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1. EMPIRICAL FORMULAS FOR THE CLEAVAGE ENERGY OF THE BORON BOND P'an Chia-'Lai p 1–4 refs (See N64-26399 18-07)

2. PREPARATION AND PROPERTIES OF SOME RARE-EARTH TITANATES Chang Hui-Min p 5–12 refs (See N64-26400 18-18)

N64-26399 Joint Publications Research Service, Washington, D.C.
EMPIRICAL FORMULAS FOR THE CLEAVAGE ENERGY OF THE BORON BOND
P'an Chia-lai *In its* Transl. on Communist China's Sci. and Technol., no. 98 21 Jul. 1964 p 1–4 refs (See N64-26398 18-07) OTS: $0.50

Pauling's empirical formulas are used to make approximate calculations of the various cleavage energy values in the boron bond. Comparison of calculated results with experimental values shows that with the exception of the halogen-boron bond, numerical values for the other boron bonds are close. Cleavage energy and ionicity of the boron bond can be used to determine the relative stability of the various boron bonds. R.T.K.

N64-26405* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE ANALYSIS OF DYNAMIC BEHAVIOR OF HIGH POLYMERS
P. H. Fang Repr. from Polymer Letters, v. 2, 1964 p 613–616 refs
(NASA-RP-257)

A method is proposed for analysis of the dynamic behavior of high polymers. One of the results of this method shows that the characteristic time, based on experimental data, is only of the order of 10^{-8} sec, although Bordoni, Nuovo, and Verfini found the characteristic time of partial relaxation in polymethyl methacrylate to be in the order of 10^{-18} sec. R.T.K.

N64-26433 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
THE CRYSTALLOGRAPHY OF SOME TRANSITION METAL MOLYBDATES
R. C. Carlston and D. Rodier Mar. 1964 38 p refs
(RM-229)

Although there is increased interest in transition metal compounds, and some indication that the scheelite structure may provide a basis for laser materials, little is known about the molybdates of third transition metals. The formation of transition metal molybdates in the binary $MO\text{-}MoO_3$ with M = Mn, Ni, Co, Mg was investigated. Magnesium, although not a transition metal, was included because of the structural similarity of many magnesium and manganese compounds. Only molybdate (VI) compounds were studied. In a standard procedure the materials were weighed, blended in a P-K blender, and fired. The blending was done dry or in alcohol. In the latter the alcohol was dried off at 110° C. Grinding was not done, since the powders were generally 200 mesh. The firings were mostly done in sealed Vycor tubes, although some early firings were done in platinum crucibles. The pseudo binaries (assuming oxygen balance constant) have not yet been completely investigated, and the results are preliminary. Low symmetries seem to characterize this type of molybdate, and the powder patterns described were not deciphered. Single crystals were not grown in this program. Author

N64-26487 Du Pont de Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.
DETERMINATION OF METALLIC IMPURITIES IN WATER BY ATOMIC ABSORPTION SPECTROMETRY
J. Allen Wheat Jun. 1964 17 p refs
(Contract AT(07-2)-1)
(DP-879) OTS: $0.50

The technique of atomic absorption spectrometry was studied with a single-beam grating monochromator. The limits of detection of several metals were extended up to 25-fold by increasing the length of the absorbing source, multiple-passing the analytical beam, using fuel-rich flames, varying fuel gases, and/or pumping sample solutions into the flame. The determination of down to 20 to 500 ppb of Fe, Cr, Ni, Co, Mn, and Cu in water was achieved. The coefficient of variation ranged from 4% at 10 to 100 times the limit of detection to 15% at twice the limit of detection. Author

N64-26490 Louvain U., (Belgium) Lab. for Inorganic Chemistry

IONIZATION IN FLAMES AND IDENTIFICATION OF THE NEGATIVE FLAME IONS Scientific Report No. 4

A. Van Tiggelen May 1964 40 p refs

(Contract AF 61(052)-398)

(ARL-64-104; AD-600456)

A summary is given of the most representative actual data concerning the measurement of the chemi-ion concentration in the flame reaction zone, the identification of these ions, and the rate of their recombination in the afterburning zone. A few possible processes for their formation are discussed; an estimate of the rate of such process is given. Some relations are derived concerning the most probable values of the ion concentrations in the flame front. Ions were produced in the flame gases by electron bombardment; the electrons are those normally present in the flame owing to its proper content of chemi-ions. The also formed "secondary ions" were identified by mass spectrometry. This work gives information on the nature of some transitory combustion products in the flame. The identity of the negative ions in the flame was investigated. A first important conclusion concerns the large concentration of negative ions whose amount is comparable to the amount of positive ions; therefore it is not true that the electrons are the main negative charge carriers. Author

N64-26515 Bureau of Mines, Albany, Ore. Albany Metallurgy Research Center

X-RAY SPECTROGRAPHIC ANALYSIS FOR TRACE QUANTITIES OF TANTALUM IN COLUMBIUM

Peter A. Romans, W. J. Niebuhr, and J. R. Hauger 1964 15 p refs

(BM-RI-6483)

With suitable instrumentation and techniques it is possible to determine the presence of tantalum in columbium to 20 ppm. This paper discusses the selection of X-ray spectrographic instrumentation and describes a technique for accomplishing the low-level determination of tantalum. An ion-exchange method of separating tantalum from columbium is also described. Author

N64-26538 Glasgow U. (Gt. Brit.)

STRUCTURE OF AN ANOMALOUS HETEROCYCLIC INTERMEDIATE, BY X-RAY CRYSTAL ANALYSIS

J. Monteath Robertson [1963] 9 p refs

(Contract DA-ERO-91-591-3-G-0004)

(AD-600436)

In the preparation of the disulfide of 2-(2-mercaptoethylamino)-2-oxazoline from 2-methylthio-2-oxazoline and 2-mercaptoethylamine hydrochloride, an intermediate with anomalous properties was encountered. The properties of this intermediate, $C_5H_{10}N_2OS$, were not consistent with its formulation as the anticipated 2-(2-mercaptoethylamino)-2-oxazoline, and spectroscopic evidence (infrared and nuclear magnetic resonance spectra) suggested the possibility that a novel heterocyclic spiran had been obtained. In order to establish the structure of this anomalous intermediate unambiguously, an X-ray crystal-structure analysis was made. Results of this analysis established the molecule as a substituted thiazoline, 2-(2-hydroxyethylamino)-2-thiazoline. The position of the double bond between the heterocyclic carbon and amino nitrogen was determined by consideration of the bond lengths and valence angles. I.v.L.

N64-26590* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

THE FLUORINATION OF COPPER

Patricia M. O'Donnell and A. E. Spakowski Repr. from J. Electrochem. Soc., v. 3, no. 6, Jun. 1964 p 633–636 refs

(NASA-RP-265)

The reaction between fluorine gas and copper metal was studied at 450° C and pressures from 10- to 130-mm Hg. The reaction was pressure dependent and followed the logarithmic law, $y = K \log (at + c) + C$. The logarithmic rate constant K varied with pressure according to the equation $\log K = m \log P$-6.11439 where m is equal to 0.781. Analysis of the corrosion film yielded a F/Cu ratio of 1.11. A reaction mechanism is postulated, and from evidence presented fluorine is considered the migrating species in the reaction. Author

N64-26615 Notre Dame U., Ind.

SYNTHESIS AND EVALUATION OF POLYMERS WITH SPECIAL PROPERTIES Summary Report

G. F. D'Alelio, R. C. Evers, T. Dehner, and T. Hoffend 13 Mar. 1964 35 p refs

(Contract DA-11-022-AMC-169(A))

(AD-600063)

The monomers 1-acryloxy-2-butyne and 1-methacryloxy-2-butyne formed crosslinked polymers with radical and cationic initiators. Linear, uncrosslinked polymers were prepared from these two monomers with anionic initiators such as sodium and butyl lithium. These linear polymers contained free acetylenic groups that could undergo post reactions with bromine to give a dibromide derivative, with decaborane to give a carborane, and to undergo crosslinking as a post reaction. In contrast, the butyne monomers that contained a terminal acetylenic hydrogen produced complicated products of undetermined structure. The thermal and radical crosslinking of the linear polymers indicate their potential use as thermosetting adhesives whereas the post-brominated polymers may be useful for their self-existingushing properties. The polymeric carboranes may find utility as fuels and as neutron-capture media. Author

N64-26619 Louisiana State U. and Agricultural and Mechanical Coll., Baton Rouge Coates Chemical Lab.

THE INFLUENCE OF SURFACE ROUGHNESS ON SOLID ELECTRODES ON ELECTROCHEMICAL MEASUREMENTS

R. de Levie May 1964 32 p refs Submitted for Publication

(Contract Nonr-1575(04))

(TR-54; AD-600842)

The influence of surface roughness of solid electrodes on electrochemical measurements is critically examined. A model and its mathematical consequences are presented that describe the effects in at least a semiquantitative way. The conclusion is drawn that the neglect of surface roughness has led to apparent misinterpretations in literature, and that great caution should be exercised in this respect. Author

N64-26635 Melpar, Inc., Falls Church, Va.

STUDY OF CHEMICAL AGENT DECONTAMINATION SYSTEMS FOR MULTIPURPOSE USE Bimonthly Progress Report, 17 Feb.–20 Apr. 1964

Z. Oser, S. Preis, F. A. Serafin, J. L. Poling, and H. E. Podall [1964] 64 p refs

(Contract DA-18-108-AMC-203(A))

(BPR-5; AD-600061)

Competitive hydrogen transfer studies were conducted for methyl benzoate, diisopropyl methyl phosphonate (DIMP), GB, GF, and HD vs carbon tetrachloride in each case employing phenylazotriphenylmethane (PAT) as a source of phenyl radicals. The cooxidation of GB with benzaldehyde, and of GF with 2,2-azobis (isobutyronitrile) (AIBN), indene, and with

cyclooctene were investigated at 25° C. The kinetics of the autoxidation of GF in the presence of Co(II) catalyst at 75° to 135° C were investigated. In addition, the autoxidation reaction was investigated in the absence of catalyst and in the presence of varying quantities of catalyst. The effect of 2,6-di-*tert*-butylphenol (DTBP) as an inhibitor was investigated. The autoxidation of HD in the absence and in the presence of Co (II) catalyst at 105° C was examined. The use of ferrous phthalocyanine as a heterogeneous catalyst for the autoxidation of GF at 25° C was examined. The results obtained are compared with those reported for the autoxidation of carboxylic esters. Author

N64-26639 Sandia Corp., Albuquerque, N. Mex.
THE OXIDATION OF U(IV) BY T1(III) IN THE PRESENCE OF CHLORIDE IN AN AQUEOUS SOLUTION
James O. Wear Jun. 1964 15 p refs
(SC-RR-64-552) OTS: $0.50

The kinetics of the oxidation of U(IV) by T1(III) were examined in aqueous-chloride-perchlorate solution with the chloride concentration varied from 10^{-4} to 1 M. The reaction was suppressed by chloride over most of the range, but at high chloride concentration the reaction was independent of chloride. The data were explained by mechanisms involving chloro and hydroxy complexes of both U(IV) and T1(III). The temperature was varied from 15° to 50° C and the activation energy was found for each rate constant. Author

N64-26645 Illinois U., Urbana
THE EFFECT OF MOLECULAR STRUCTURE ON THE CLEAVAGE OF OXYGEN-OXYGEN BONDS Final Report
J. C. Martin, David Tuleen, Ernest Drew, Thomas Koenig, Thomas Fisher et al Feb. 1963 6 p
(Grant DA-ARO(D)-31-124-G6)
(AROD-2454-7; AD-437567)

The importance of bridging to suitable neighboring groups in the transition states of reactions leading to free radicals has been demonstrated by kinetic studies on several systems. Accelerations of 0–0 bond cleavage by a factor of as much as 10^5 was observed in favorable cases when sulfide sulfur is the neighboring group. Oxygen-18 tracer techniques were used to extend the concept to include the postulation of a bridged intermediate radical in one case. Author

N64-26650 Union Carbide Nuclear Corp., Paducah, Ky.
PLASMA TORCH PRODUCTION OF ELEMENTAL BORON
G. E. Biggerstaff, W. R. Golliher, R. L. Harris, and W. R. Rossmassier 26 Feb. 1964 46 p refs
(Contract W-7405-ENG-26)
(KY-453)

A feasibility study was made on the production of elemental boron by the reduction of BF_3 and BCl_3 in a plasma system. The study was successful in producing elemental boron from both boron halides. The maximum yields obtained per pass through the torch were 30% with BF_3 and 60% with BCl_3. The chemical purity of the boron produced was as high as 94.6% with BF_3 and 99.1% with BCl_3. The major impurities were nitrogen and oxygen that originated as contamination in the feed and plasma gases. Results indicate that further development could lead to a commercially feasible process. Author

N64-26689 Pennsalt Chemicals Corp., King of Prussia, Pa. Contract Research Dept.
THE COMPATIBILITY OF WELDED STRUCTURAL MATERIALS WITH CHLORINE TRIFLUORIDE, PERCHLORYL FLUORIDE AND A MIXTURE OF THESE Technical Summary Report, Apr. 1962–Jan. 1964
John C. Grigger and Henry C. Miller Feb. 1964 244 p refs
(Contract AF 33(657)-8461)
(ML-TDR-64-22; AD-600000)

Compatibility and corrosion rates of 9 welded alloys of aluminum, nickel, and stainless steel, stressed and unstressed, in ClF_3, ClO_3F, and 25% ClO_3F–75% ClF_3 at 30° and 66° C were investigated. Corrosion rates at 30° C were all less than 0.1 mil/yr. At 66° C, corrosion in ClF_3 and Halox 25 was less than 0.1 mil/yr except for Type 410 S.S. (1 to 2.2 mil/yr). In ClO_3F at 66° C corrosion was normally below 0.5 mil/yr, but with moisture present, rates up to 8.3 mil/yr were observed. No change in mechanical properties and no stress cracking due to oxidizer corrosion occurred. There was no interface corrosion. In an ambient temperature, high-pressure loop, liquid flows of ClF_3 and ClO_3F at 100 ft/sec through orifices in aluminum, nickel, and stainless steel caused no erosion. A Teflon orifice was attacked by ClF_3. Liquid impingement jets of ClF_3 and ClO_3F at 100 ft/sec had no effect on these metals except for a slight pit in aluminum 2014-T6 with ClF_3. Liquid cavitation of ClF_3 and ClO_3F in an aluminum tube caused no metal change. Author

N64-26716 Imperial Coll. of Science and Tech., London, (Gt. Brit.)
ADSORPTION AND SORPTION COMPLEXES Quarterly Technical Status Report No. 2, 1 Oct.–31 Dec. 1963
J. L. Whiteman 24 Jan. 1964 6 p
(Contract DA-91-591-EUC-2980)
(QTSR-2; AD-439607)

The properties of the inclusion complexes formed between phosphorus and synthetic faujasite (NaX) were studied at 264° C. In the region where the phosphorous content is below 400 mg per g of anhydrous sorbent, both sorption and desorption take place at rates that fall as the process proceeds. Desorption of phosphorus does not begin until the phosphorus pressure has been lowered to 0.1 cm of mercury. Another interesting feature of the isotherm is the residual weight increase of approximately 30 mg per g that remains when the phosphorus pressure has been reduced to zero by cooling the reservoir with solid carbon dioxide. X-ray photographs of silver zeolites after sorption of mercury followed by removal of this sorbate were also investigated to determine the mechanism by which the copious mercury sorption of silver zeolites occurs. R.T.K.

N64-26720 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
COMPARATIVE CHARACTERISTICS OF SPECTROPHOTOMETRIC METHODS FOR IDENTIFYING TANTALUM AND NIOBIUM
A. T. Pilipenko and O. M. Eremenko 27 May 1964 14 p refs
Transl. into ENGLISH from Ukr. Khim. Zh. (Kiev), v. 29, no. 5, 1963 p 532–538
(FTD-TT-64-370/1+2+4; AD-602330)

A comparative study was made of spectrophotometric methods for determination of tantalum and niobium with inorganic reagents. A formal molar extinction coefficient was used for comparing methods. Absorption spectra studies were made of compounds of niobium and tantalum and inorganic reagents that were used for their photometric identification. The best inorganic reagent method for niobium identification is the ether-extraction method. In determination of niobium

in the presence of tungsten, it is better to apply the thiocyanate method in a water–acetone medium; here the sensitivity decreases but the adverse influence of tungsten is lessened. Author

N64-26732 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

COMPOUNDS OF INDIUM WITH GLYCOCOLL

A. P. Kochetkov, V. G. Tropev, and O. N. Gilyarov 3 Jun. 1964 8p refs Trans. into ENGLISH from Zh. Neorg. Khim. (Moscow), v. 8, no. 3, 1963 p 772–774

(FTD-MT-63-279; AD-402592)

Compounds of indium with glycine (glyco coll), of the general formula $In(GlH)_{3-n}Gl_nCl_{3-n}$ (n = 0, 1, 2, 3) were synthesized and studied for the purpose of comparing them with the corresponding compounds of gallium and also for the purpose of explaining the question of how the gradual closing of glycine rings, under the action of an alkali, affects the stability of the compounds. This study of the synthesized compounds of indium with glycine of the compositions $In(GlH)_3Cl_3$, $In(GlH)_2GlCl_2$, and $InGl_3$ showed that ring formation increased the thermal stability of the compounds, while, as distinguished from the corresponding compounds of gallium (concerning the action of ammomia gas under pressure), the indium–nitrogen bond both in the triglycinate and in triglycinochlorides is equally unstable. I.v.L.

N64-26762 Princeton U., N.J. Frick Chemical Lab.

NEW CRYOGENIC METHOD FOR RAMAN STUDIES OF MOLECULAR CRYSTALS

R. Savoie and A. Anderson Jul. 1964 13 p refs

(Contract Nonr-1858(27))

(TR-17)

A new technique was developed for growing good quality molecular crystals, suitable for Raman studies at low temperatures. The method utilizes a copper rod, cooled by a suitable refrigerant, which lies axially in the sample tube. The crystal grows radially around the rod from the melt. Liquid nitrogen and helium cryostats, incorporating this method, for use with the Cary 81 Spectrophotometer, are described. These can be readily modified to suit other Raman instruments. Low Rayleigh scattering near the exciting line and the very sharp spectral lines of a number of samples so far studied indicate the good quality of such crystals, grown in a relatively short time. Author

N64-26800 Los Alamos Scientific Lab., N. Mex.

AN ALTERNATIVE TREATMENT OF SOLVENT ACTIVITY IN THE RAOULT'S LAW REGION. THE GALLIUM-CADMIUM SYSTEM

Guy R. B. Elliott, Joe Fred Lemons, and Harold S. Swofford, Jr. (Minn. U.) 27 Jul. 1964 44 p refs

(Contract W-7405-ENG-36)

(LA-2997) OTS: $1.00

The applicability of the equation $a_1 = 1 - k'N_2$ (where a_1 is the activity of the solvent, N_2 is the mole fraction of the solute, and k' is a constant) to dilute solutions is discussed and contrasted with Raoult's Law. The activity of Cd in dilute solutions of Ga in Cd was determined experimentally, and the data were fitted to the equation. Data from the literature were discussed in terms of their fit to the above equation or Raoult's Law, and the application of the Gibbs–Duhem treatment in concentrated solutions is commented on. Author

N64-26815 Naval Research Lab., Washington, D.C. Chemistry Div.

MORPHOLOGY OF PbO_2 IN THE POSITIVE PLATES OF LEAD ACID CELLS

Jeanne Burbank 11 Jun. 1964 10 p refs

(NRL-6048; AD-348354)

Several preparations of PbO_2 including positive active material from lead antimony and lead calcium cells were examined by electron microscopy. The morphology of the particles is believed to have a bearing on positive paste retention and plate performance in the lead acid cell. The anodic coating of PbO_2 formed on pure lead sheet H_2SO_4 was prismatic when first formed, but lost its prismatic character upon prolonged anodization and upon cycling. Author

N64-26820 Lockheed Missiles and Space Co., Sunnyvale, Calif.

THE FUNDAMENTAL EFFECTS OF RADIATION AND "HOT ATOMS" ON SIMPLE COMPOUNDS: AN ANNOTATED BIBLIOGRAPHY

Charlie M. Pierce, comp. and Richard A. Glass, comp. Apr. 1963 335 p refs

(Contract AF 04(647)-787)

(SB-63-37; Rept.-8-19-63-9; AD-443451)

References that are related to the effects of hot atoms and radiation on simple compounds and aqueous solutions are listed. Particular attention was given to the selection of references that involve the halogen compounds. The references are arranged according to the first author. Indexes for corporate author, personal author, and subject are included. The period covers the years 1947 to January 1963. Author

N64-26825 General Applied Science Labs., Inc., Westbury, N.Y.

A THEORETICAL INVESTIGATION OF HYDROGEN-AIR REACTIONS. PART I: BEHAVIOR WITH ELABORATE CHEMISTRY Technical Report No. 250

P. A. Libby, H. S. Pergament, and M. H. Bloom Aug. 1961 54 p refs

(Contract AF 49(638)-991)

(AFOSR-1378; AD-266515)

As part of a study of hydrogen–air reactions under conditions of interest in propulsive devices, a theoretical analysis of these reactions with an elaborate description of the chemical behavior considered was carried out. The system was idealized so as to result in an adiabatic, isobaric process. The present analysis yields the temperature and composition histories for a range of initial temperatures, mixture ratios, and pressures. Author

N64-26855 Air Force Systems Command, Wright-Patterson AFB, Ohio Research and Technology Div.

A PLASMA ARC TECHNIQUE FOR THE SPECTROCHEMICAL DETERMINATION OF TITANIUM AND ZIRCONIUM IN MOLYBDENUM Technical Documentary Report, Sep. 1963–Dec. 1963

James H. Muntz Mar. 1964 14 p refs

(ML-TDR-64-36; AD-435863)

A plasma arc technique was developed for the spectrochemical determination of titanium and zirconium in molybdenum alloys. Titanium is determined in the 0.25% to 1.5% range and zirconium in the 0.05% to 0.4% range with an overall precision of about ±5% and an accuracy that approaches the precision. Sensitivity for the zirconium determination

is achieved by using high gas flow and high amperage. Molybdenum is used as the internal standard, and a background correction is necessary to produce a straight-line analytical curve for zirconium over the concentration range of interest. Author

N64-26860 Harvard U., Cambridge, Mass. Mallinckrodt Chemical Lab.
THE MICROWAVE SPECTRUM OF METHYL HYPOCHLORITE
John S. Rigden and Samuel S. Butcher (Natl. Res. Council, Ottawa) [1963] 22 p refs
(Contract Nonr-1866(14))
(AD-437343)

The microwave spectra of the normal species and some isotopically substituted species of methyl hypochlorite (CH_3OCl) have been investigated in the frequency region 9,000 to 38,000 mc. Analysis of the results indicates the following structural parameters: $d(CH)_{av} = 1.099A$, $< HCH_{av} = 109.4°$, $d(OCl) = 1.674A$, $d(OC) = 1.389$ A, and $< COCl = 112.8°$. The quadrupole coupling constants for CH_3OCl^{35} are $eQq = -84.34$ mc. and $\eta = 0.408$. The coupling constants for CD_3OCl and the structural data indicate that the quadrupole tensor is probably cylindrically symmetric. The barrier to internal rotation calculated from splittings in the $v_{torsion} = 1$ state for CH_3OCl^{35} is 3060 ± 150 cal/mole. Author

N64-26861 Harvard U., Cambridge, Mass.
THE MASS AND MICROWAVE SPECTRA, STRUCTURES AND DIPOLE MOMENTS OF THE ISOMERS OF SULFUR-MONOFLUORIDE
Robert L. Kuczkowski [1963] 24 p refs
(Contract Nonr-1866(14))
(AD-434344)

Two isomers of S_2F_2 were prepared by heating AgF and S. The relative mass spectral cracking patterns of both isomers are reported. For one isomer, microwave transitions for the $S^{32} = S^{32}F_2$, $S^{32} = S^{34}F_2$, and $S^{34} = S^{32}F_2$ species were obtained. The structure was determined to be pyramidal $S = SF_2$ with $d(SS) = 1.860 \pm 0.015$ A, $d(SF) = 1.598 \pm 0.012$ A, $\angle FSS = 107.5° \pm 1°$, and $\angle SSF = 92.5° \pm 1°$. The dipole moment was 1.03 ± 0.03 D. For the second isomer, microwave transitions for the $FS^{32}S^{32}F$ and $FS^{32}S^{34}F$ species were obtained. The structure was determined to be nonplanar chain FSSF with $d(SS) = 1.888 \pm 0.01$ A., $d(SF) = 1.635 \pm 0.01$ A., $\angle FSS = 108.3° \pm 0.5°$, and the dihedral angle $= 87.9° \pm 1.5°$. The dipole moment was 1.45 ± 0.02 D. A discussion of the observed structural parameters for both isomers is given. Author

N64-26871* California U., Berkeley Aeronautical Sciences Lab.
THE STUDY OF BASE HEATING BY RADIATION FROM EXHAUST GASES Thirteenth Quarterly Progress Report, Feb. 1, 1963–Apr. 31, 1964
W. H. Giedt and C. L. Tien 14 May 1964 22 p refs
(Contract NAS8-850)
(NASA-CR-58208) OTS: $2.60

The study is executed in two phases—the experimental and the analytical programs. The experimental program investigates base heating, using a test run with argon inside and helium outside a zirconia tube, at a temperature of 2,800° F. There is no fracture in the zirconia tube at this temperature, probably because of the high thermal conductivity of helium. In the analytical program, the calculation of radiation from a gas body that is nonuniform in temperature is presented, along with a procedure for evaluating the radiation incident on the center of a base plate from a nonisothermal, nongray cylindrical gas body. The nongray gas of CO_2 shows less effect from nonuniform temperature than does the gray gas, because of the increasing contribution of a 15-micron band as the temperature decreases. This indicates that the actual absorption spectrum plays an important role in the determination of emissivity of a nonisothermal gas body. J.L.C.

N64-26900 International Union of Pure and Applied Chemistry, Basle (Switzerland) Commission on High Temperatures and Refractories
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS IN THE CONDENSED STATE, VOLUME 1964, NUMBER 2, APRIL, MAY, JUNE 1964
J. J. Diamond , ed. (Natl. Bur. Std., Washington) [1964] 70 p refs

08 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; telemetry; tracking; and wave propagation. *For tracking stations see*: 10 Facilities, Research and Support. *For related information see*: 06 Auxiliary Systems; 09 Electronics; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-25859 Stanford Research Inst., Menlo Park, Calif.
COUPLED MODE THEORY FOR ADVANCED MICROWAVE DEVICES
M. C. Pease and C. W. Barnes Apr. 1964 56 p refs
(Contract AF 33(657)-8343)
(IR-8; AD-438256)

The structure theorems of semisimple Lie algebras are shown to provide the coupling diagram of a system whose system matrix is a known curve in a given Lie algebra; that is, from the algebra a directed line graph is developed that exhibits the possible interactions between the modes that the system may have. The diagram is "topological" in that it shows the possible couplings, but not their strengths, or even whether or not they are present at all. However, in view of the fact that the diagram is applicable to all types of systems—multimode uniform periodic, and general nonuniform—it seems to be a tool of substantial importance in the study of general coupled mode systems. The theory of projectors is extended to include operators that may not be semisimple and is applied. As an example, it is shown that the general solution of the matrix wave equation can be written in a form analogous to the general solution of the scalar wave equation, provided the form is properly interpreted. Author

N64-25884 National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
MICROPULSATIONS Quarterly Technical Report, Jan. 1-Mar 31, 1964
W. H. Campbell Apr. 1964 3 p
(ARPA Order 183)
(AD-439884)

The nature of natural electromagnetic phenomena in the frequency range of 0.004 c/s to 3.0 c/s is investigated. J.L.D.

N64-25891 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
IONOSPHERIC CONTRIBUTIONS TO THE DOPPLER SHIFT AT VHF FROM NEAR-EARTH SATELLITES
W. H. Guier Jul. 1963 58 p refs
(Contract NOW-62-0604-c)
(CM-1040; AD-600285)

The ionospheric contributions to the nonrelativistic doppler shift at VHF from satellites above the ionosphere are considered to $O(1/f_s^3)$ where f_s is the satellite transmitter frequency and the vacuum doppler shift is considered of $O(f_s)$. It is shown that to $O(1/f_s^3)$, the phase of the electromagnetic radiation field from the satellite cannot be approximated by the usual Fermat integral of geometric optics. Through a consideration of the characteristics of an ideal doppler tracking receiver, boundary conditions are imposed on the solution to the wave equation containing the ionosphere electron contribution to the refractive index such that the solution to $O(1/f_s^3)$ in the phase is obtained. It is shown that to this order Fermat's principle can still be applied if the index of refraction is modified by terms containing gradients of the electron density. This generalized Fermat's principle is used to obtain the ionospheric contributions to the doppler shift to $O(1/f_s^3)$ at VHF. Upper bounds for the various terms are estimated. Author

N64-25897 Harvard U., Cambridge, Mass. Cruft Lab.
TRANSIENT RESPONSE OF A CLASS OF RECTANGULAR LOOP ANTENNAS
Trilochan Padhi 17 Oct. 1963 23 p
(Contract Nonr-1866(26))
(NR-371-015; TR-426; AD-600797)

This report presents experimental investigations on the transient response characteristics of rectangular loop antennas with one pair of sides of length much smaller than the cutoff wavelength of the measuring apparatus. An approximate theory is also presented that agrees quantitatively with the experimental results. Author

N64-25898 Johns Hopkins U., Baltimore, Md. Carlyle Barton Lab.
STATISTICAL PROPERTIES OF NOISE PULSES
A. J. Rainal Jun. 1964 39 p refs
(Contract AF 33(657)-11029)
(AF-109; AD-600796)

This report presents some theoretical properties of noise pulses generated by a random process crossing a fixed threshold level. The random waveshapes of the noise pulses are determined solely by the underlying random process and the fixed threshold level. For an arbitrary threshold level, this report considers the durations of the noise pulses, the average pulse amplitude, the RMS pulse amplitude, the average pulse area, and the average pulse energy when the underlying random process is either a sinusoidal process, a gaussian process, or the envelope of a gaussian process. Some numerical results are presented in graphs. Author

N64-25980 Lincoln Lab., Mass. Inst. of Tech., Lexington
PROPOSAL FOR 7.75–8.35 kMcps DIPLEXER USING SIDE-WALL COUPLERS AND CUT-OFF GUIDE Group Report 1964-22
J. A. Kostriza 24 Apr. 1964 11 p
(Contract AF 19(628)-500)
(ESD-TDR-64-52; AD-600332)

A diplexer may be made using two side-wall couplers interconnected by cutoff guides. Isolation is controlled by the length of the interconnecting lines. A sample design is worked out for 7.75 to 8.35 kmc in full- and half-height WR-112 guide. Author

N64-26026* Massachusetts Inst. of Tech. Cambridge
NOTE ON BINAURAL MASKING-LEVEL DIFFERENCES AT HIGH FREQUENCIES
N. I. Durlach Repr. from J. Acoust. Soc. of Am., v. 36, no. 13, Mar. 1964 p 576–581
(Grant NsG-496)

A quantitative black-box model is developed for use in interpreting certain data on binaural masking-level differences at high frequencies. The basic idea of this model is that these differences are the result of variations in the extent to which the envelopes of the signals presented to the two ears of the listener are unequal. Author

N64-26044 Gt. Brit. Dept. of Scientific and Industrial Research, Slough Radio Research Station
KINETHEODOLITE OBSERVATION OF SATELLITES RECEIVED BY THE PREDICTION SERVICE, 1964 ISSUE 3
1964 73 p Film taken at COSPAR Station 2366, Royal Obs. of Edinburgh

These are series of tables giving results of British observations of several American and Russian satellites, including Midas V, Transit 2A, Sputnik IV, and Midas III. Kinetheodolite film readings are presented as are observations from the Royal Greenwich Observatory. G.D.B.

N64-26122 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON THE REFRACTION AND DOPPLER SHIFT OF RADIOWAVES RADIATED BY ARTIFICIAL EARTH SATELLITES IN A THREE-DIMENSIONAL HETEROGENEOUS IONOSPHERE
Ya. L. Al'pert 25 May 1964 18 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 3, no. 4, 1963 p 626–634
(FTD-TT-64-384/1+2+4; AD-602313)

On the basis of the Fermat principle, using its analogy with the principle of least action, equations of the Lagrange–Euler type are written for the ionosphere and, from these, a generalized law for refraction in a three-dimensional–heterogeneous medium was formulated. Formulas were obtained for the refraction angles and the doppler shift of radio waves radiated by a source located in the ionosphere. A situation is examined which is realizable with artificial earth satellite (AES) experiments, when the wave frequency is sufficiently great For this case the doppler shift depends linearly on the localized value of electron concentration N_c in the vicinity of the emitter, on the refraction angles $\delta\Phi_0$ and $\delta\psi_0$ near the observation point in two planes (S_0x and S_0y) that are mutually perpendicular relative to it and to the source, and on the average gradient values of the electron concentration $\overline{dN}/dx$ and $\overline{dN}/dy$ along the trajectory of wave S. The corresponding analysis of doppler shift component $\delta\Phi$ caused by the influence of the ionosphere and measurable upon coherent radio waves radiation from AES makes it possible to determine all of these values. Author

N64-26167 American Inst. for Research, Pittsburgh, Pa.
THE EXPERIMENTAL EVALUATION OF MULTISENSOR INTELLIGENCE SYSTEMS Final Report
Lewis D. Hannah, James W. Altman, Robert W. Smith, Eugenia S. Scharf, and Earl L. Seiler Griffiss AFB, N.Y., RADC, Jun. 1964 129 p refs
(Contract AF 30(602)-3223)
(RADC-TDR-64-160; AD-602837)

A series of experiments, designed to investigate critical problem areas in the presentation of multisensor intelligence

imagery, was designed and is presented. The group of sensors considered includes a panoramic camera, an image-forming side looking radar system, and an image-forming infrared sensing system. The individual problems were studied in the context of the complete multisensor intelligence collecting and evaluation system. Experiments related to the individual problems are presented in three design groups, each of which is focused on a major problem area. The first design group is centered on the image-forming characteristics of the sensors under different collection conditions, the characteristics of images formed, and the performance of interpreters as it is related to both of these. The second design group presents a systematic way of determination of optimum values of parameters relevant to the forced scan mode of image interpretation and a way of evaluating the use of this mode, with a scanning device designed on the basis of the derived optimum values. The third design group develops methods to be used in the study of the parameters of the simultaneous presentation of multisensor imagery, and the evaluation of equipment designed for such presentations. Author

N64-26168 Applied Psychology Corp., Arlington, Va.
COMPARATIVE STUDY OF THREE AIRBORNE IMAGE SENSORS Final Report
Griffiss AFB, N.Y., RADC, June 1964 133 p refs
(Contract AF 30(602)-3222)
(RADC-TDR-64-181; AD-602626)

This report presents an analysis and discussion of issues relevant to planning research to examine the contributions of multisensor imagery to intelligence requirements. Parameters influencing imagery are examined to determine how the influences can be specified in terms of scale, resolution, contrast, or other effects. Experimental designs are presented that allow for expansion and trade-off as subjects and imagery become available. The relevance of ground truth and image truth to image collection system losses and performance evaluation is examined. Finally, a basis is presented for construction of measures of proficiency of image interpreters who will serve as subjects in research on image reconnaissance systems. Such measures can be used to select, match, or train subjects to given levels of proficiency. Author

N64-26170 Bell Telephone Labs., Inc., New York, N.Y.
DISTRIBUTED SATELLITE CIRCUMGLOBAL COMMUNICATION TECHNIQUE STUDY, VOLUME I Final Report
R. E. Graham, I. Jacobs, T. T. Kadota, H. Morrison, A. D. Whalen et al Griffiss AFB, N.Y., RADC, May 1964 169 p refs
(Contract AF 30(602)-2668)
(RADC-TDR-64-187, Vol. I; AD-602436)

The purpose of this investigation is to provide an initial evaluation of techniques applicable to a global communications network utilizing orbiting dipoles as a scattering medium. Emphasis has been placed on those techniques that are peculiar to the propagation medium employed. Consideration of the scattering mechanism led to development of a quaternary modulation technique. An analysis has been made of the performance of various error correcting and error detecting codes that can be used in conjunction with a one of five modulation system. The doppler spread was calculated very accurately as a function of the orbital parameters and station geometry. Transmission calculations were made and performance of the system compared to that of a discrete passive satellite system. Author

N64-26172 Radio Corp. of America, Lancaster, Pa. Industrial Tube and Semiconductor Div.
APPLIED RESEARCH ON HIGH RESOLUTION CAMERA TUBES Technical Documentary Report, 1 Apr.–31 May 1964
O. H. Schade, Sr., B. H. Vine, and A. Rotow Wright-Patterson AFB, Ohio, AF Avionics Lab., 8 Jul. 1964 102 p
(Contract AF 33(657)-7939)
(AL-TDR-64-171; AD-602425)

To achieve the desired resolution and signal-to-noise ratio, tubes with vidicon photoconductive targets were built with the required 2- × 2-in. image area. Photoconductive targets typically achieve the 40-db signal-to-noise ratio and give 2,000 TV lines at 50% response. In addition, when a suitable distribution of magnetic focus field is used, there is very little reduction of resolution from the center to the corners of the image, and furthermore, no dynamic focus modulation is required. The vidicon tubes with field mesh and uniform potential within the deflection space are the most satisfactory even in spite of the fact that some degradation of resolution, due to the 1,000 line-per-inch mesh, is present. A study was made of the magnetic focus and deflection fields and of the path of beam under various focus field configurations and deflection amplitudes. A start was made toward computer calculation of beam aberrations in the measured field distributions. Although additional work was done toward plug-type integral mesh targets, the improvements made were not sufficient to make these targets practical. Author

N64-26179 Sperry Gyroscope Co., Great Neck, N.Y. Radiation Div.
MULTIPLATE ANTENNA FEED Final Engineering Report
S. Milazz, J. Lo May 1964 156 p
(Contract AF 19(628)-2966)
(EB-5297-0460; AFCRL-64-422; AD-602444)

This report describes the design of a multiplate antenna feed system that consists of tower- and ground mounted equipment. The feed illuminates each of four elliptical multiplate apertures on the ground, producing a single beam on transmit, and a square cluster of 25 beams on receive. The feed system includes techniques for antenna frequency dispersion correction, sidelobe suppression, and polarization control. Various aspects of the feed design, including multiple-beam networks, dispersion correction filters, radiation patterns, phase-locked loops, signal amplification and processing, duplexing, and equipment packaging are described. Author

N64-26180 Instituto Nacional de Electronica, Madrid (Spain)
MEASUREMENTS OF THE 5 kc RADIO NOISE NEAR MADRID
C. F. Schlayer 15 May 1964 22 p refs
(Contract AF 61(052)-513)
(AFCRL-64-530; AD-603038)

During a 3 year period, the 5-kc noise was continuously recorded near Madrid. These records were part of a larger program comprising other stations whose data were gathered at the ACRL for evaluation. The installations are described, and a short relation of some characteristic details of the obtained curves is given. Author

N64-26185 Washington U., Seattle Coll. of Engineering
THINNING AND BROADBANDING ANTENNA ARRAYS BY UNEQUAL SPACINGS Technical Report No. 83
Akira Ishimaru and Y-S. Chen Mar. 1964 34 p refs
(Contract AF 19(628)-2763)
(AFCRL-64-253; AD-602637)

This paper presents a theory for, and a method of, designing a thinned or broadband antenna array by means of unequal spacings. Using the theory of unequally spaced arrays developed by one of the authors, an antenna array can be designed to produce a desired beamwidth and sidelobe level with the average spacing many wavelengths apart. The patterns are expressed in a series of the Anger functions, and its sidelobe level is shown to decrease approximately as $N^{-0.4}$ where N is the total number of elements, and the gain is approximately equal to N. It is also shown that the sidelobe level can be improved by varying the amplitude distribution. Numerical examples are given to illustrate the method. Author

N64-26193 Syracuse U., N.Y.
APPLICATION OF TUNNEL DIODES AS ACTIVE SCATTERER LOADS
H. Gruenberg and T. W. Bristol Griffiss AFB, N.Y., RADC, Jun. 1964 30 p refs
(Contract AF 30(602)-2900)
(RADC-TDR-64-216; AD-602836)

This report consists of preliminary studies related to the application of active loads, such as tunnel diodes, to antenna systems for the purpose of enhancing the echo area. Problems discussed include the elaboration of the relevant diode characteristics, an optimization procedure for a dipole-tunnel diode system, stability considerations, and some thoughts on the treatment of nets of diodes as negative-resistance sheets. Author

N64-26209 New York U., N.Y. Lab. for Electroscience Research
DESIGN OF BANDLIMITED SIGNALS FOR BINARY COMMUNICATION USING SIMPLE CORRELATION DETECTION Scientific Report No. 16
Burton R. Saltzberg and Ludwik Kurz Feb. 1964 51 p refs
(Contract AF 19(604)-6168)
(TR-400-90; AFCRL-64-289; AD-602712)

This paper considers the design of binary signals for transmission over a channel with additive white gaussian noise, and binary signals to be received by a memoryless correlation detector. The requirements of partial and total bandwidth limitations are considered. The signal is chosen so as to minimize the probability of error due to the combined effects of the noise and intersymbol interference. The resultant signals for both types of bandwidth limitation are expressed in terms of prolate spheroidal wave functions. The method of signal design presented can be used successfully to improve the performance of feedback communication links. Author

N64-26219 Hughes Aircraft Co., Culver City, Calif.
STUDY OF ADVANCED ANTENNA TECHNIQUES FOR AEROSPACE VEHICLE DOPPLER VELOCITY SENSORS
J. R. Miller et al Wright-Patterson AFB, Ohio. AF Avionics Lab., Jul. 1964 64 p refs
(Contract AF 33(657)-10672)
(AL-TDR-64-163; AD-602843)

A four-port, dual-mode antenna that generates four symmetrically oriented beams about its normal was designed and built. Approximately a 30-db isolation between ports was measured with this two-dimensional slot array, and overall efficiency of the antenna was 71%. Agreement between theory and experiment was good for all parameters. Author

N64-26222 Utah U., Salt Lake City Upper Air Research Lab.
TEST OF TELESCOPING ANTENNAS FOR HIGH SPIN-RATE ROCKETS Scientific Report No. 2
Ralph Haycock 6 Apr. 1964 17 p refs
(Contract AF 19(628)-447)
(AFCRL-64-430; AD-602441)

This report presents the theoretical calculations and the results of a series of tests on 10-ft aluminum telescoping antennas to determine their suitability for use on high spin rockets. In particular, tests and calculations were made for a rocket the size of a Javelin with a spin rate of 10 rps. Tests were also made to determine the lowest spin rate sufficient to extend the antenna by centrifugal force. The calculations and tests indicated that 10-ft centrifugal erecting antennas were suitable for use on a Javelin type rocket having a spin rate between 2 and 10 rps. Author

N64-26224 Ionosphären-Institut Breisach (W. Germany)
FIXED AND VARIABLE FREQUENCY PULSE TRANSMISSION AT OBLIQUE IONOSPHERIC INCIDENCE
K. Bibl 5 Dec. 1963 35 p refs
(Contract AF 61(052)-129)
(IIB-8; AFCRL-64-392; AD-603045)

Transatlantic pulse transmission on two HF frequencies has been used to study amplitude variations of the different (multihop) paths. Comparison with backscatter received at the transmitting station gave additional information. From a variable frequency pulse transmission established between Breisach and Athens (1,709 km) the operational frequency range could be derived for the different modes. Author

N64-26231 Sylvania Electric Products, Inc., Williamsville, N.Y. Sylvania Electronic Systems-Central Div.
ELECTRONICALLY STEERABLE ARRAY FOR SPACE VEHICLE APPLICATIONS Third Quarterly Report
Griffiss AFB, N.Y., RADC, Feb. 1964 41 p
(Contract AF 30(602)-3041)
(RADC-TDR-64-15; AD-602415)

The design of the ferrite-evaluation experiments is described. Ferrite material properties were investigated, and materials were selected. Frequency and magnetic-field operating regions were chosen, and expected results are given. D.E.W

N64-26243 Brown (D.) Associates, Inc., Eau Gallie, Fla.
INVESTIGATION OF THE FEASIBILITY OF SELF-CALIBRATION OF TRACKING SYSTEMS Final Report
Duane C. Brown, Norman Bush, and Jerome Sibol 29 May 1964 222 p refs
(Contract AF 19(628)-3286)
(AFCRL-64-441; AD-602799)

The Error Model Best Estimate of Trajectory (EMBET) is derived for a tracking system measuring any linear combination of ranges and range rates. Provisions are made for the introduction of any functional or statistical constraints on the coefficients of the error model. Provisions are also made for the introduction of dynamic constraints expressed either in terms of explicit functions or in terms of general differential equations of motion. A rigorous extension of EMBET to apply to a hierarchy of orbits (rather than individual trajectory points) is developed. It provides an altogether practical solution to the long standing problem of the simultaneous adjustment of all observations made by all sensors on an unlimited number of orbits or epochal intervals. This extension, called NEO-EMBET (N-Epoch Orbital EMBET), also calibrates both stable and unstable components of the error models of all observational

channels while simultaneously estimating the orbital parameters at all specified epochs, as well as any gravitational and drag parameters considered to be unknown. The theory is applied to simulated observations of a single orbital pass made by (1) a hypothetical six station range-range rate system, (2) the MISTRAM tracking system, and (3) a single high precision radar. Author

N64-26244 Philco Corp., Blue Bell, Pa. Advanced Technology Center
ADVANCED ANTENNA TECHNIQUES Final Report, 1 Dec. 1962–31 Mar. 1964
Leo W. Procopio, Thomas K. Kashihara, and Stephen Czorpita May 1964 84 p
(Contract AF 19(628)-2403)
(AFCRL-64-421; AD-602768)

A generalized theory of resolution for array antennas was formulated. The theory indicates that angular resolution is determined by the width of the autocorrelation function of the field pattern, and not by the width of the pattern itself. Hence, a well-defined main beam is not a prerequisite for achieving angular resolution; even noiselike beams can be characterized by an autocorrelation function of narrow width. This basic principle leads to the concept of angular dispersion and compression, a phenomenon for angular beam patterns akin to dispersion and compression of radar pulses. During the course of the study new procedures were formulated for synthesizing antennas of given resolution properties. The resolution theory was applied to antennas with time-invariant and time-varying illumination functions, and was used to reexamine in some detail the classical theories of superdirectivity. In addition to an exposition of angular resolution theory, preliminary concepts for achieving angular dispersion and compression, and superdirectivity were also investigated. Angular dispersion–compression techniques may give rise to significant simplifications in present phased array designs. Author

N64-26266 Lincoln Lab., Mass. Inst. of Tech., Lexington
THE WEST FORD ANTENNA SYSTEM Technical Report no. 338
B. F. La Page 6 Dec. 1963 47 p refs
(Contract AF 19(628)-500)
(ESD-TDR-63-591; AD-438879)

The West Ford orbital scatter communications system consists of two installations—one located at Camp Parks, Pleasanton, California, and the other located at Westford, Massachusetts. Each site employs a 60-ft-diam Cassegrainian antenna system operating near 8 Gcps. This presentation covers the requirements, design, and performance of two related low-noise feed systems for the West Ford antennas. One feed provides an on-axis beam only, the second feed produces tracking beams and a simultaneously operated low-noise communications beam. The design and performance of some auxiliary components, such as a polarizer, diplexer, and radome, are also discussed. Author

N64-26267 Colorado U., Boulder
MODEL STUDY OF IONOSPHERE PERTURBATIONS AND PROPAGATION BETWEEN TWO SITES Quarterly Report, 1 Jan.–1 Apr. 1964
[1964] 2 p
(ARPA Order 183-62; Contract NBS CST-7348)
(QPR-9; AD-438193)

The final series of experiments in the "idealized" model waveguide (with "perfectly conducting" boundaries) were completed. The effective height profile in the nonuniform section of the multimode waveguide was of a gradually varying nature with no discontinuities in the height or in the gradient of the height. Theoretical solutions have shown good correspondence with the experimental data obtained from the model waveguide. Measurements of the attenuation and propagation constant in the uniform waveguide with finite surface impedance compare very well with the calculated data for the principal incident mode. Work has also been done on the waveguide termination. R.T.K.

N64-26282 Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.
JOHNSTON ISLAND WIDEBAND EM MONITORING SYSTEM
C. B. Dobbie, S. R. Hamilton, A. H. Libby, and W. F. Crewson 12 Feb. 1964 86 p
(Contract AF 33(600)-42403; ARPA Order 159)
(EG&G-B-2668; AD-440102)

A wideband electromagnetic monitoring system was installed and operated on Johnston Island during Operation Fish Bowl. System operation, difficulties encountered, and corrective measures during Operation Fish Bowl are described. Schematics, block diagrams, and subsystem photographs are included. D.E.W.

N64-26296 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
TE°_{01} CROSS-GUIDE TRANSDUCER
N. Lipetz and C. Neudorfer Oct. 1963 38 p refs
(USAELRDL-TR-2389; AD-437137)

An interest in the TE_{01} mode in circular waveguide as a transmission medium has greatly increased over the past few years because of its low loss and high power handling characteristics. Since most microwave generators are available only in a rectangular waveguide output, it is necessary that rectangular-to-circular waveguide transducers be made available for use in circular waveguide systems. Such a transducer was developed, which is compact and exhibits a mode purity of greater than 22 db and a VSWR less than 1.2:1 over a 13% bandwidth centered at 7.5 Gc. The steps taken to achieve these objectives are described, and dimensions are given of the final transducer. Included is a brief discussion of mode purity measuring techniques. Author

N64-26316 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Instrumentation Dept.
A DOUBLY-FED SLOT ANTENNA
Reed L. Warnock Nov. 1963 11 p refs
(ERDA-74; AD-440973)

This report discusses the design of a doubly fed slot antenna for the ARCAS missile. The antenna is capable of operating simultaneously at 1.0 Gc and 1.69 Gc. The antenna installation was confined to a space 4 1/2 in. in diameter and 11 1/2 in. in length. Author

N64-26319 Columbia U., New York, N.Y. Electronics Research Labs.
ELECTRO-OPTICAL SIGNAL PROCESSING TECHNIQUES FOR PHASED ARRAY ANTENNAS Quarterly Progress Report P-2/199, 1 Jan.–31 Mar. 1964
L. Lambert 1 Apr. 1964 33 p refs
(Contract AF 49(638)-1113; ARPA Order 279)
(CU-35-64-AF-1113-ERL; AD-440342)

The research program for an electro-optical signal processor for phased array antennas is continued. In this phase of the program, particular emphasis is placed on the spatial multiplexing technique and the resulting sidelobe response of the system. The theoretical envelope response for a cosine amplitude weighted aperture using a channel separator mask is presented. New techniques and equipment developed to facilitate the measurements of the resolution and sidelobe response of the system are discussed. This includes the 24-channel input signal simulator, the mechanical scan mechanism, x–y recorder, and a 40-db dynamic range photomultiplier circuit. Experimental measurements of the resolution and sidelobe response of the processor with and without the light modulator and channel separator mask in the collimated region are presented. These results indicate that the optical system with its associated components produces a nearly diffraction-limited light distribution at the output focal plane. Thus, the theoretical dynamic range of 30 db can be achieved. Author

N64-26341 Navy Electronics Lab., San Diego, Calif.
LINEAR AND NONLINEAR CORRELATORS FOR PSEUDO-RANDOM SIGNAL DETECTION. A THEORETICAL AND EXPERIMENTAL STUDY OF THE OUTPUT CHARACTERISTICS OF CORRELATORS FOR ACTIVE SONAR SYSTEMS
C. E. Persons, M. K. Brandon, and R. M. Zarnowitz 23 Mar. 1964 55 p refs
(NEL-1219; AD-443161)

This is a theoretical and experimental study of several types of correlators to determine or verify the relationship between the cross-correlation function of the input signals and the system output. The study covered analog correlators, polarity-coincidence correlators, DELTIC difference-frequency correlators, multicoded-signal polarity-coincidence correlators, multilevel (binary-encoded) DELTIC correlators, and hybrid correlators (one input limited, one input analog). Most of the systems were simulated on a high-accuracy analog correlator. The data on the polarity-coincidence, DELTIC difference-frequency, and binary-encoded DELTIC difference-frequency correlators were obtained with practical correlation systems. Author

N64-26352 Israel Program for Scientific Translations, Ltd., Jerusalem
ASSEMBLY OF RADIO AND ALLIED ELECTRONIC EQUIPMENT
V.O. Bukler and Yu. I. Rabinovich [1963] 257 p refs Transl. into ENGLISH of the book "Sborka Radioapparatury" Moscow, Gosenergoizdat, 1960
(OTS-61-31204) OTS: $2.50

This book contains the basic and most important data on the assembly of radio and allied electronic equipment. It describes many of the processes of radio-equipment production, such as metal and insulation material processing, finishing, plating, and hermetic sealing of components and of whole units. Special attention is paid to the requirements of severe climatic conditions, and to the qualities of radio-electronic equipment that are necessary to satisfy these requirements. Several chapters deal with the assembly of UHF equipment and of indicating mechanisms. Assembly of measuring devices and various aspects of quality control are also dealt with. Author

N64-26448 RAND Corp., Santa Monica, Calif.
COMPLETE SCATTERING PARAMETERS OF POLYDISPERSED HYDROMETEORS IN THE Λ0.1 TO Λ10 CM RANGE
D. Deirmendjian May 1964 14 p refs For Presentation at the 1964 World Conf. on Radio Meteorol., Boulder, Colo., 14–18 Sep. 1964
(P-2914; AD-600693)

An investigation was made of the backscattering and attenuation properties of cloud and precipitation elements in the microwave region. The theoretical investigation had two purposes—to introduce a realistic size spectrum for the precipitation drops, including those found near the base of a cloud, and to evaluate as exactly as possible all the rational scattering parameters that are necessary inputs for the formulation of the equivalent radiative transfer problem. In addition to the scattering and absorption radiative transfer coefficients, the parameters studied included polarization at any scattering angle, per unit volume of space with precipitation and/or cloud particles. P.V.E.

N64-26505 Harvard U., Cambridge, Mass. Cruft Lab.
THE ADMITTANCE OF BARE CIRCULAR LOOP ANTENNAS IN A DISSIPATIVE MEDIUM Technical Report No. 419
R. W. P. King, C. W. Harrison, Jr., and D. G. Tingley 5 Aug. 1963 29 p refs
(Contract Nonr-1866(32))
(NR-371-016; AD-600539)

The normalized input admittance of thin bare circular loop antennas has been evaluated from the theory of T. T. Wu. Computations have been made for loops in air and in an infinite homogeneous isotropic dissipative medium. A comparison is also made with Storer's theory of the loop. Numerical results are given in the form of graphs for several wire sizes and for loops up to 2.5 wavelengths in circumference. The properties of the medium are represented by the ratio α/β in the range from zero (perfect dielectric) to one (good conductor); α and β are the imaginary and real parts of the complex propagation constant $k = \beta - j\alpha = \omega\sqrt{\mu(\epsilon - j\sigma/\omega)}$ where μ is the permeability, ϵ the dielectric constant, and σ the conductivity of the medium. Author

N64-26535 Harvard U., Cambridge, Mass. Cruft Lab.
MATRIX REPRESENTATION OF MULTI-LOADED CIRCULAR LOOP ANTENNAS
Keigo Iizuka 18 Nov. 1963 68 p refs
(Contract Nonr-1866(32))
(TR-429; AD-600460)

Studies were made of both the driving-point impedance and the amplitude and phase distributions of the current in a circular loop driven by an arbitrary number of delta-function generators and loaded with an arbitrary number of lumped impedances. The only restriction imposed in the present treatment is that the elements (either generator or load) are spaced at equal intervals of $2\pi/mb$ along the circumference where m is the total number of elements and b is the radius of the loop. The numerical calculations include loads with negative resistances in order to take account of loops loaded with an element like an Easki tunnel diode, with proper precautions against both self-oscillation and switching effects. A study of such precautions is to be considered separately. Extensive computations have been carried out for loops loaded with a single resistor at $\phi = \pi$ or $\phi = \pi/2$ as well as loops with two resistors at $\phi = 2\pi/3$ and $-2\pi/3$. The resistances used ranged from -100 through 100 ohms; the sizes of the loops from $\beta b = 0.2$ to 2.4, where β is the real part of the propagation constant k. The experimental results agree quite well with theory except for the larger values of βb. Author

N64-26549 Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.

POWER SPECTRAL DENSITY ESTIMATES OF THE FADING OF HIGH FREQUENCY RADIO WAVES

D. H. Schrader May 1963 72 p refs

(DI-82-0244)

The power spectral density of the fading power of high-frequency radio waves and methods of estimating this function are the subject of this report. Evaluations of the power spectral density estimates obtained by two different methods are made. The asymptotic low-frequency variation of estimates computed on a digital computer and the expected value of estimates computed with an analog computer are derived. A comparison of the two methods is made, and power spectral density estimates computed by both methods are shown. Power spectral density estimates are shown for eight different data samples. In general, the power density is confined to frequencies below 1 cps. Author

N64-26555 National Research Council of Canada, Ottawa Radio and Electrical Engineering Div.

BULLETIN OF THE RADIO AND ELECTRICAL ENGINEERING DIVISION, NATIONAL RESEARCH COUNCIL OF CANADA, VOL. 14, NO. 1, JANUARY–MARCH, 1964

Mar. 1964 76 p refs

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N64-26556 Georgia Inst. of Tech., Atlanta Engineering Experiment Station

SIGNAL PROCESSING BY INFINITE CLIPPING AND RELATED TECHNIQUES Final Report, 16 Aug. 1963–31 Mar. 1964

Berry O. Pyron and Frank R. Williamson, Jr. 1 Apr. 1964 126 p refs

(Contract DA-49-092-ARO-21)

(AD-600863)

Infinite peak clipping was studied as a technique for processing speech and other signals. Current and past utilization of this technique was surveyed briefly, and limited experimental and theoretical studies were performed. A new explanation is advanced for the high intelligibility of infinitely clipped speech, and a technique is suggested for achieving an acceptable compromise between the improved resistance to noise or jamming (or, alternatively, reduction in transmitted power) provided by infinitely clipped speech with amplitude modulation, and the concomitant reduction in quality and voice recognition. A possible system for speech bandwidth compression using a signal obtained by infinite clipping is described, and results of simple experiments are given. Also described is a type of visual display that produces patterns on speech signals that tend to show high correlation with the spoken word and its enunciation, and low correlation with the particular voice speaking. Fields of application for the techniques discussed include radio communication systems, antijamming measures, acoustic systems, speech bandwidth compression, speech therapy and training, automatic recognition of speech, doppler radar signal analysis, and analysis of phonocardiographic and other physiological signals for medical diagnosis. Author

N64-26612 Weapons Research Establishment (Australia)

A THEORETICAL STUDY OF THE MEDIUM LENGTH YAGI ARRAY

H. E. Green Oct. 1963 23 p refs

(WRE-TN-PAD-75)

This paper treats yagi arrays containing between 3 and 10 elements and having specified conductor diameters and interelement spacings by the classical coupled circuit method. An IBM-7090 computer program based on this approach is outlined, and an extensive table of results prepared from it is included. In addition to their obvious use as engineering design data these results are also discussed from a theoretical point of view. Author

N64-26643 Watkins-Johnson Co., Palo Alto, Calif. Lincoln Lab., Mass. Inst. of Tech., Lexington

[DEVELOPMENT OF A GRIDDED 100 kw L-BAND AMPLIFIER SUITABLE FOR APPLICATION IN PHASED-ARRAY RADAR SYSTEMS] Monthly Technical Progress Report, 1 Sept.–31 Oct. 1963

Merton V. Purnell 20 Nov. 1963 8 p Prepared for Lincoln Lab., MIT

(Contract AF 19(628)-500)

(MTPR-22; AD-438129)

Several types of focusing structures were tried on the 100-kw traveling-wave tube. Best results were obtained by using the grounded circuit tube in a solenoid. Another method of focusing the tube was to use a PPM magnet stack. Results of tests on RF defocusing caused by beam modulation at the reversal are also reported. R.T.K.

N64-26667* Hughes Aircraft Co., El Segundo, Calif.

DEEP SPACE OPTICAL COMMUNICATIONS SYSTEMS STUDY

Washington, NASA, Jul. 1964 232 p refs Previously Published as NASA-CR-56466; see N64-22447 15-08)

(Contract NAS9-879)

(NASA-CR-73; NASA-CR-56466) OTS: $3.50

The feasibility and desirability of using the laser and suitable optical detectors in a communication system that will provide two-way telemetry, voice, and down-TV from distances of the order of 50 million miles were studied. The problems in the practical utilization of the detectors in a laser communication system are discussed and operating problems of numerous lasers are characterized. The statistical nature of the noise from the various lasers (i.e., its coherence and stability properties) are examined, and various types of modulation systems are discussed. The properties of various physical devices and their effective utilization in light modulation are discussed. Various demodulation systems are outlined, and a theoretical comparison is made to establish a performance characterization as a function of frequency, bandwidth, and external noise. The effects of attenuation and external noise sources on system performance are established; the optimum operating frequency selection and the source-destination selection are also established. P.V.E.

N64-26677 Lincoln Lab., Mass. Inst. of Tech., Lexington
SPACE COMMUNICATIONS Quarterly Progress Report, Division 6, 1 Apr.–30 Aug. 1963
T. F. Rogers and G. P. Dinneen 15 Sep. 1963 30 p refs
(Contract AF 19(628)-500)
(QPR-1; AD-437879)

Research efforts are reported in the following areas: (1) RF components, (2) surface techniques and equipment, (3) space techniques and equipment, (4) transmission techniques, (5) applications—networks, modulation, and coding, (6) analysis—space communications and mathematical analysis, (7) radio physics, (8) radar, and (9) engineering—West Ford Project, and compact terminal—analog orbit computer, and cryogenics for low-noise receivers. R.T.K.

N64-26695 New York U., N.Y. Courant Inst. of Mathematical Sciences
DIFFRACTION OF ELECTROMAGNETIC WAVES BY A CIRCULAR APERTURE IN AN INFINITELY CONDUCTING PLANE SCREEN
J. Bazer and L. Rubenfeld Mar. 1964 50 p refs
(Contract AF 19(604)-5238)
(EM-195; AFCRL-64-244; AD-600132)

The problem of the diffraction of electromagnetic waves by a circular aperture in an infinitely conducting planar screen is studied. Attention is focused chiefly on the low-frequency end of the spectrum where the product ka of the wave number k and the aperture radius a is small. Transverse electric and transverse magnetic modal excitation appropriate to the cylindrical geometry of the problem is assumed. New integral representations of the solution corresponding to incident fields of this kind are presented. These representations, which involve a pair of unknown functions, are designed so as to automatically satisfy Maxwell's equations, the boundary conditions, the radiation condition, and all but one of the edge conditions. The unknown functions satisfy a pair of integro-differential equations that follow directly from the representations by means of an elementary calculation. Convergent power series solutions of these integro-differential equations are readily obtained for small enough ka, when it is assumed merely that the excitation is sufficiently regular in the aperture. These results are employed to derive the first terms in the power series expansions of the far fields, the edge fields, and the aperture fields; and the transmission coefficients were also derived. When the incident transverse electric and magnetic modes are specialized to those that occur in plane wave excitation, these expressions reduce to the well-known plane, wave formulas obtained by other means. Author

N64-26705* Avco Corp., Wilmington, Mass.
A REENTRY VOICE COMMUNICATION SYSTEM FOR USE IN CONJUNCTION WITH RADAR TRACKING EQUIPMENT
Washington, NASA, Jul. 1964 181 p refs
(Contract NASw-586)
(NASA-CR-74) OTS: $3.00

The design and development of the Astrovoice II space communications system are described. This system is capable of transmitting encoded voice or other data from a vehicle in space to one or more ground stations, via a radar link that is simultaneously used for vehicle tracking. A pulse position modulation technique is used in encoding data for transmission. The use of this system in conjunction with radar-tracking equipment, operating at C-band frequencies, enables communication to be maintained during hypersonic reentry despite the plasma-induced signal attenuation accompanying such reentry. The Astrovoice II system has excellent potential for deep-space-probe communication applications, particularly for the transmission of low-information-rate (less than 3 kc/s) PPM data. I.v.L.

N64-26721 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
MAGNETIC RECORD-READ CHANNEL EVALUATION
Ya. A. Khetagurov 19 May 1964 10 p Transl. into ENGLISH from Vychislitel'naya Tekhn., Mosk. Inzh.-Fiz. Inst., no. 2, 1961 p 3–7
(FTD-TT-64-235/1+4; AD-601551)

One of the most important characteristics of magnetic drum recording used in discrete-type devices is the density of the recording. Increasing this density results in a compact memory device that operates at high frequency. To determine what recording density may be obtained with various methods and systems of magnetic-drum pulse recording systems, it is necessary to determine the relationship between the recording current, recording density, read-out signal, and magnetic coating characteristics, as well as the peculiarities of the magnetic head construction. In this report these dependencies are determined by using a pulse recorded at a static position on a nonrotating drum. The magnitude of the record pulse current is selected so that the recording medium goes into saturation during magnetic reversal. Bringing the recording medium to saturation during pulse recording will be characterized by a change in the read signal-to-record current ratio. A sharp change in this ratio indicates that the recording medium went into saturation. To analyze this ratio, an approximation of the law of magnetic flux variation is performed in such a way that its derivative will yield the shape of the signal taken off by the read-out head. I.v.L.

N64-26760 Lincoln Lab., Mass. Inst. of Tech., Lexington
RADAR SCATTERING FROM A CONDUCTING CONE-SPHERE Technical Report 349
J. H. Pannell, J. Rheinstein, and A. F. Smith 2 Mar. 1964 41 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-37; AD-600411)

As part of an investigation of the radar backscatter properties of axisymmetric conducting shapes, a study was made of backscattering by a cone-sphere. This body is comprised of a circular cone with a 25° included cone angle, terminated by a tangent spherical segment. Measurements of backscatter cross sections over all aspect angles are presented for wavelengths in the range from one-tenth to twice the radius of the spherical segment. Comparison of measured values with theoretical predictions shows that satisfactory agreement is obtained for all aspect angles. Author

N64-26763 Radiation, Inc., Melbourne, Fla.
REDUNDANCY REDUCTION DEVICE Final Report, Jul. 1962–Apr. 1964
A. J. Scott and J. S. Norcross 5 May 1964 43 p
(Contract AF 33(657)-9210)
(AL-TDR-64-10; AD-600766)

A study was conducted to establish and evaluate techniques for the reduction of redundancy in pulse code modulated (PCM) telemetry data. Experimental equipment was designed and fabricated to demonstrate one of the techniques developed in the course of the study. The equipment provides for processing up to four multiplexed segments of either real or simulated data in a prescribed format to determine the effect of redundancy reduction on the reconstructed data. Two general types of redundancy reduction techniques were examined. The first depends upon detecting periods during which the magnitude

of the data samples changes less than some assigned tolerance. This technique requires a step interpolation in the reconstruction of the data. The second type detects the periods during which the data are changing by a nearly constant amount between adjacent samples. These techniques permit linear interpolation between nonredundant samples. The various techniques were compared for their relative effectiveness in achieving a reduction in transmitted bit rate. It is concluded that the appropriateness of applying a particular technique depends upon the nature of the data, the initial sampling rate, and the use to which the data are to be put. More importantly, the application of redundancy reduction should be considered as a part of a complete telemetry system design problem and not as a separate feature to be added to an existing system. Author

N64-26881 New York U., N.Y. Courant Inst. of Mathematical Sciences

PHENOMENOLOGICAL THEORY OF MULTI-MODE SURFACE WAVE EXCITATION, PROPAGATION AND DIFFRACTION. I: PLANE STRUCTURES

Samuel N. Karp and Frank C. Karal, Jr. Apr. 1964 37 p refs
(Contract AF 19(628)-3868)
(EM-198; AFCRL-64-332; AD-602420)

The purpose of this paper is to study the electromagnetic field that arises when a magnetic dipole source is located above a plane structure that supports several surface waves, if the surface of the structure is characterized by a general impedance boundary condition. This is the first time that this condition has been introduced. An exact solution is given for plane surfaces supporting one, two, and three surface waves. The magnitudes of the surface waves are obtained, and simple formulas are given for the radiated far-field patterns. It is shown how the methods employed in this paper can be extended to the case of plane structures that support any number of surface waves. I.v.L.

N64-26896 Radio Corp. of America, Camden, N.J. Communication Systems Div.

VOCODER EVALUATION RESEARCH Final Report

W. F. Meeker and A. L. Nelson 29 Feb. 1964 88 p
(Contract AF 19(604)-8507)
(CR-64-558-1; AFCRL-64-453; AD-602955)

In support of research in digital speech transmission and speech bandwidth compression several related tasks were completed. Master tape recordings of speech from 38 male and 19 female talkers were provided using microphones, preamplifiers, and equalizers duplicating those used for speech recordings. Material recorded by each talker consisted of 20 minutes of continuous speech, a regional dialect check list, a nonsense syllable list, and 6 PB word lists. Articulation tests were conducted to evaluate several vocoder configurations and data rates for two experimental vocoders at AFCRL. An analysis was made of phonetic errors for one vocoder configuration. Author

N64-26902 Hughes Aircraft Co., Culver City, Calif. Antenna Dept.

DOPPLER ANTENNA INVESTIGATION Final Report

A. T. Villeneuve, F. G. Terrio, L. E. Gates, Jr., P. M. Winslow, and W. H. Wheeler Wright-Patterson AFB, Ohio, Jul. 1964 66 p refs
(Contract AF 04(695)-250)
(P-64-15; AL-TDR-64-162; AD-603059)

This report presents the results of a study dealing with the effects of factors such as high temperature and vehicle maneuvers on a rectangular flat plate slot array antenna for lift-reentry vehicles. The study consists of an investigation of slot closure techniques that will preserve the electrical performance of the antenna under severe environmental conditions. This consisted of a materials study to determine suitable metals and dielectric materials that have compatible thermodynamic characteristics up to temperatures of 2,500° F. When suitable materials were determined, a number of dielectric to metal bonding techniques were investigated experimentally. The most successful of these bonding techniques was then investigated to determine the electrical properties of the configuration. The second part of the study consisted of an investigation of the problem of beam stabilization in the presence of vehicle pitch, roll, and yaw maneuvers. Author

N64-26915 Naval Research Lab., Washington, D.C. Electronics Div.

DESIGN CONSIDERATIONS FOR TWO-DIMENSIONAL SYMMETRIC BOOTLACE LENSES

M. L. Kales and R. M. Brown 18 May 1964 16 p refs
(NRL-6075; AD-602377)

It is generally known that a symmetrical bootlace lens having two pairs of conjugate foci can be designed. Additionally, there is a bootlace lens, the R-2R, which focuses perfectly at infinitely many points. The R-2R is unique—there are no other perfect bootlace lenses, and in fact, no others with more than two pairs of conjugate off-axis foci. Author

N64-26922 Massachusetts Inst. of Tech., Cambridge Aerophysics Lab.

WIND TUNNEL STUDIES OF ANTENNA BREAKDOWN. PART I: INFLUENCE OF FORCED CONVECTION ONLY Scientific Report No. 1

Eugene E. Covert and James B. Coffin Mar. 1964 50 p refs
(Contract AF 19(628)-2434)
(MIT-AL-TR-92; AFCRL-64-282(1); AD-603036)

This report describes the studies that were carried out to illustrate the effect of velocity on the breakdown of a VHF and X-band antenna. The studies were carried out in a supersonic wind tunnel in a relatively un-ionized gas stream. Author

N64-26930* Consultants and Designers, Inc., Arlington, Va.

ON THE INTERPRETATION OF ECHOS AT A GREAT DISTANCE OBSERVED ON CERTAIN IONOGRAMS OF THE SATELLITE "ALOUETTE" [SUR L'INTERPRETATION D'ECHOS A GRANDE DISTANCE OBSERVES SUR CERTAINS IONOGRAMMES DU SATELLITE "ALOUETTE"]

Francois Du Castel 30 Jul. 1964 6 p refs Transl. into ENGLISH from C. R. Acad. Sci., Ionosphere (Paris), v. 258, no. 23, 8 Jun. 1964 p 5689–5691
(Contract NAS5-3760)
(NASA-TT-F-8934; ST-AI-10183)

Certain ionograms received by the satellite Aloutte showed the existence of two different types of trails, often very different from the normal trails, and occupying, in general, a band of threshold frequencies. This report proposes to interpret these two types of trails as originating from the same sheet of ionization. The first type, occupying a frequency band that extends from the critical frequency of reflection f_0 to the neighborhood of the satellite up to a frequency f_1, would be due to a guided propagation when the satellite crosses the waveguide formed by the sheet. The second type, occupying a frequency band that extends from a frequency f_z (greater than f_0) up to a frequency f_2 (greater than f_1), would be due to a guided propagation, when the satellite is outside of the waveguide. The knowledge of these threshold frequencies permits the calculation of the characteristics of the sheet of

ionization. Such sheets are particularly elaborate forms of the structure of the upper ionosphere and are governed by the terrestrial magnetic field. I.v.L.

N64-26939 Microwave Associates, Inc., Burlington, Mass.
BROADBAND MICROWAVE POWER LIMITERS Quarterly Report, 1 Apr.–30 Jun. 1964
L Nathanson [1964] 15 p
(Contract NObsr-89462)
(QR-4; AD-602793)

A directional crystal power sampler was developed that may be placed at any arbitrary distance in front of the input switching diode. This directional coupler is a resistive loop device that couples both electrically and magnetically. If the resistance were infinite, the probe would couple electrically and would provide a signal proportional to only the line voltage. If the resistance were zero, the probe would couple magnetically and would provide a signal proportional to the current only. An intermediate value of resistance causes the probe to respond to both voltage and current. The device operates on the principle that a backward-traveling wave has the phase of its current reversed, and this reversed signal can be used to cancel the one obtained from the backward-traveling voltage. I.v.L.

N64-26941 Illinois U., Urbana Antenna Lab.
A LOG-PERIODIC CAVITY-BACKED SLOT ANTENNA
V. A. Mikenas Jun. 1964 77 p refs
(Contract AF 33(657)-10474)
(TR-78; AD-602389)

The need for flush-mounted antennas has been increasing with the rapid advance in the design of very-high-speed aircraft. With this in mind, equivalent circuits of dipole arrays, a single resonating cavity, a log-periodic cavity-backed slot array, a uniform periodic array, and a second log-periodic cavity-slot array were investigated. Results demonstrated that the principles for successful operation of the free-space log-periodic dipole array may be usefully applied to the design of a broadband antenna mounted below a conducting ground plane and radiating through it. This type of broadband antenna is, therefore, in the form of a cavity-slot radiator. Although design data are not yet available, it has been shown that such an antenna is entirely feasible. At the present stage of development, the basic problem is that of finding a model that operates satisfactorily and then varying its parameters so as to discover and to predict their parameters' roles and significance. I.v.L.

N64-26943 Colorado U., Boulder
MODEL STUDIES OF THE INFLUENCE OF IONOSPHERE PERTURBATIONS ON VLF PROPAGATION
E. Bahar (Ph.D. Thesis) 5 May 1964 222 p refs
(Contract NBS CST-7348; ARPA Order 183-62)
(AD-440475)

The quasi-optical technique developed renders very satisfactory solutions for the scattering coefficients in nonuniform multimode waveguides with finite surface impedance boundaries. A significant advantage of these solutions is that they afford a very clear physical picture of the scattering process. The results of the investigations in this dissertation are by no means restricted to the case of propagation in the earth–ionosphere waveguide, and several applications to other problems are indicated. The benefits of the modeling technique in substantiating theoretical investigations are clearly shown. Furthermore, the experimental data also indicate a clue to the possible solution. Author

09 ELECTRONICS

Includes circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory. *For related information see*: 06 Auxiliary Systems; 08 Communications; 15 Instrumentation and Photography; 22 Navigation and Guidance; and 25 Physics, Solid-State.

N64-25856 Westinghouse Electric Corp., Elmira, N.Y.
DESIGN AND DEVELOPMENT INVESTIGATIONS OF A LOW NOISE, LINEAR, VARIABLE GAIN, R.F. AMPLIFIER TUBE Third Quarterly Progress Report, Jan. 1–Mar. 31, 1964
J. P. Pietrzyk, A van der Jagt, and R. L. Pear 15 Apr. 1964 41 p
(Contract NObsr-89530)
(AD-438401)

The main purpose of a new design, construction D, was to reduce the noise level and to make the tube better suited for the high-frequency range. For that reason we raised the transconductance to approximately 2,500 μmho. A very good Ib/Ic2 ratio beneficial to the noise was achieved. During the period, work was also done on automatic gain control. Experiments with deflection electrodes or suppressor grids did not give the required result. Construction D of the aforementioned designs seems to be most suited for the 200 to 400 mc/s range. Some induction and capacitance measurements were done to determine the best possible stem arrangement. An approach and test outline to evaluate the tubes was established. In the approach, the selected tubes will be substituted for the existing RF amplifier using an adaptor. Author

N64-25882 Lincoln Lab., Mass. Inst. of Tech., Lexington
RADIO-ECHO STUDIES OF METEORS AT 68-cm WAVELENGTH. PART I: SPORADIC METEORS Technical Report No. 332
V. V. Evans and R. A. Brockelman 29 Oct. 1963 64 p refs
(Contract AF 19(628)-500)
(ESD-TDR-63-581; AD-439354)

Radio-echo observations of meteors at 68 cm are described. Details are given of the equipment and of the data collection and reduction procedures. Sufficient information was gathered to permit the computation of the velocity, height, duration, and intensity for most of the meteors. The interrelation of these quantities is explored. The principal conclusions reached are: that the meteors recorded at this short wavelength are seen over a height range not sensibly different from that at long wavelengths, the effective scattering lengths of the trails are short ($\leq$ 50 meters), the overall lengths of the trails average 6 to 7km, and evidence of fragmentation is found in about 50% of the meteors observed. The visual magnitude of these meteors has been estimated from their rate and corresponds to +8. The short effective scattering length is attributed to a rapid initial expansion of the trail diameter. Author

N64-25883 SFD Labs., Inc., Union, N.J.
PRODUCTION ENGINEERING MEASURE FOR A Ka-BAND INVERTED COAXIAL MAGNETRON Third Quarterly Progress Report, 7 Nov. 1963–6 Feb. 1964

P. du Fosse and M. Liscio Feb. 1964 24 p
(Contract DA-36-039-AMC-01472(E))
(SFD-29-QPR-3; AD-438867)

Six model tubes of the refined mechanical design were built and evaluated. Electrical evaluation data of the six tubes are presented. Oscillation life tests and cycled heater life tests are reported. Results of the anode evaluation program and the areas of further improvement are discussed. Power output capabilities of greater than 100 kw are reported, as are the power output versus frequency characteristics of a late model tube. Author

N64-25909* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APPLICATION OF INTEGRATED CIRCUITS TO TELEMETRY SYSTEMS
J. Michael Balderson Washington, NASA, Jul. 1964 14 p
(NASA-TN-D-1905) OTS: $0.50

A continuing study of integrated circuits as applied to scientific satellite telemetry systems was initiated. This paper describes some results of investigations of standard commercially available Texas Instruments Series 51 Solid Circuits. The possibility of altering circuit functions by the addition of external components was verified. Three telemetry encoder subsystems were designed using the solid circuits. Conclusions and recommendations for future studies are presented. Author

N64-25953 Lincoln Lab., Mass. Inst. of Tech., Lexington
A REFLECTION-TYPE POLARIZER FOR THE WEST FORD ANTENNAS
B. F. La Page 30 Dec. 1963 37 p refs
(Contract AF 19(628)500)
(ESD-TDR-63-666; AD-440430)

This is a report of a theoretical study of the properties of a reflection-type wire-grid polarizer. The subreflector polarizer transforms the linearly polarized wave arriving from the feed horn into a circularly polarized wave illuminating the main paraboloid. This in turn results in a circularly polarized far-field antenna pattern. A practical supporting structure for the wire grid is analyzed, and optimum parameters are calculated. The study shows that an antenna pattern-peak axial ratio of about 2 db is attainable over a 6% band of frequencies centered at 8 Gc. Author

N64-25979 Naval Research Lab., Washington, D.C.
PARAMETRIC AMPLIFIERS AND UPCONVERTERS
Alan C. Macpherson 5 May 1964 49 p refs
(NRL-6024; AD-600405) OTS: $1.25

The purpose of this report is to place in proper perspective the role that the modern semiconductor diode low-noise amplifier and converter have in the amplification of extremely small signals. There is a discussion of the fundamental principles of parametric amplification, and a quantitive treatment that is valid in the limit of very high Q diodes. Design formulas from the literature are given and discussed for the more practical case of finite Q diodes. An engineering discussion of noise in amplifying systems is presented, because the most important characteristic of parametric amplifiers and converters is low noise. Since the parametric amplifier is built up from a two-terminal negative resistance, it is qualitatively different from the conventional amplifier (such as the vacuum tube triode and traveling wave tube). For this reason some basic material on the properties of negative resistance amplifiers is included, and several typical parametric amplifiers are presented and discussed. Author

N64-25982 CBS Labs., Stamford, Conn. Electron Tube Dept.
DEVELOPMENT OF LARGE DIAMETER HIGH CURRENT PHOTOMULTIPLIERS Final Report, Apr. 1961 – Aug. 1963
Charles E. F. Misso and John J. Morles 1 May 1964 58 p
(Contract AF 33(600)-43530; Proj. VELA)
(AD-440103)

A photosurface investigation led to a development of a photocathode, substrate, and faceplate combination that permitted large diameter S-11 photoemissive cathodes to be operated at much higher load currents than previously possible. A 24-in.-diam photomultiplier was designed and built using the above photocathode type. A 10-stage venetian-blind electron multiplier was designed with a large area secondary emissive surface, which resulted in stable operation at high currents over prolonged periods. A number of tubes were built and submitted for evaluation. Author

N64-25988 Corning Electronic Components, Bradford, Pa.
INVESTIGATION PERFORMED ON CORNING GLASS WORKS NF RESISTORS. TYPE II; PROJECT SUMMARY ON NF RESISTOR FACTORIAL LOAD LIFE TEST
Jack L. Daulton 1 May 1964 34 p
(Contract NObsr-87385)
(AD-438882)

This project was concerned with the performance of a factorial load life test on hermetically sealed, glass NF resistors. The results of this test were in the form of detailed load life performance data. Resistors of two rated power dissipating capabilities, 0.125 w and 0.250 w, were tested. In this factorial test, approximately 21,000 resistors operated at combinations of temperatures of 70°, 100°, 125°, and 150°, and power dissipating levels of one time, two times, three times, four times, and five times their normally rated power for 2,000 hours. In addition, 450 resistors were tested for 10,000 hours at 70° C under rated dissipating power. Author

N64-25990 Stanford U., Calif. Solid-State Electonics Lab.
THE QUANTIZER: AN APPLICATION OF QUANTIZATION OF TRAPPED FLUX IN SUPERCONDUCTORS
D. J. Dumin Dec. 1963 47 p refs
(Contract AF 33(616)-7726)
(SEL-63-128; AL-TDR-64-28; AD-600177)

Recent experimental evidence has shown that the flux trapped by a superconductor is quantized. The fundamental unit of trapped flux is $\phi_q = h/2e \cong 2 \cdot 10^{-7}$ gauss $cm^2 = 2 \cdot 10^{-15}$ webers. This value of flux is quite small, and in general the field associated with a unit of flux is also small (<1 gauss). Using present thin-film technology, it is possible to produce quantizing structures with flux-trapping loops of the order of $2.5 \cdot 10^{-8}$ cm^2. These loops have a field of a few gauss associated with each flux unit. This field is easily detected with superconductors. This report describes a completely superconducting system for the trapping and detecting of these quantum values of flux. The quantizer and its operating characteristics are described. Up to six levels of flux have been trapped and detected. A short discussion of material properties, speed considerations, and circuit applications is presented. Author

N64-25993 Grumman Aircraft Engineering Corp., Bethpage, N.Y. Research Dept.
SOME ELECTRICAL CHARGING PROCESSES FOR VEHICLES IN SPACE AND POSSIBLE CONSEQUENCES
A. Favale Jan. 1964 8 p ref
(RN-176L)

This report illustrates quantitatively two types of charge accrual and discusses qualitatively some charge-loss phenomena. Two methods for producing electrical charges on vehicles are discussed—vehicle charging due to the earth's own surface charge and vehicle charging due to impingement of space radiation. G.D.B.

N64-26012 Naval Ordnance Lab., Corona, Calif. Infrared Div.
TECHNIQUES AND APPARATUS FOR EVAPORATING COMPOUND SEMICONDUCTORS
G. G. Kretschmar and R. F. Potter 1 Apr. 1964 15 p refs
(NAVWEPS-8190; AD-600676)

An apparatus for producing thin films of intermetallic semiconductors is described. It has been used for producing films of indium antimonide and indium arsenide as well as mixed crystal films of these two compounds. The principal improvements over older equipments are (1) independently shielded evaporators and (2) a substrate heater suspended in quartz tubes so that the substrate can be heated by radiation from above. Author

N64-26057 Joint Publications Research Service, Washington, D.C.
APPLICATION OF TUNNEL DIODES IN HIGH-SPEED COMPUTERS
7 Jul. 1964 31 p refs Transl. into ENGLISH from Elektron. Vychislitel'nyye Mashiny, (Moscow), 1963 p 1–41
(JPRS-25-368; TT-64-31641) OTS: $0.75

An attempt is made to estimate the behavior of basic forms of single-diode and some double-diode circuits from the point of view of their reaction to the value of input current and to determine the region of optimum values of the parameters for achievement of maximum high-speed operation. The high-speed operation of the investigated circuits is estimated in a wide range of values of parameters entering them. The dependence of speed of switching and of other characteristics of the output signal on the value of the starting current is clarified. R.T.K.

N64-26062 Hughes Aircraft Co., Fullerton, Calif.
DEVELOPMENT OF RADIATION HARDENED READOUT CIRCUITS Semi-Annual Technical Report
R. L. Russell 22 May 1964 55 p refs
(Contract AF 29(601)-6282; ARPA Order 307-62)
(FR-6410-105; AD-440178)

The FOREST (Fast Ordered Radiation Effects Sampling Technique) circuit program was initiated for the purpose of developing a system of radiation hardened sampling circuits. The system is to be capable of measuring pulse characteristics such as amplitude, width, and rise time while being subjected to intense nuclear radiation, similar to that presented by a nuclear weapon detonation. Therefore, FOREST circuitry can be employed as low cost instrumentation for experiments concerned with radiation effects studies. A FOREST circuit using the radiation resistant qualities of tunnel diodes has shown promise in measuring pulse characteristics such as those encountered in radiation effects experiments. This circuit employs a tunnel diode in a bistable configuration such that an irreversible readout device can detect the change of state of the bistable circuit caused by an input pulse possessing the correct amplitude and width. Experiments were conducted to evaluate FOREST circuit performance in high level nuclear radiation fields. Author

N64-26065 Illinois U., Urbana Electrical Engineering Research Lab.
ELECTRON BEAM PARAMETRIC CONVERTER
Carl Wang Jan. 1964 63 p refs
(Contract AF 33(657)-10224)
(AL-TDR-64-64; AD-600723)

A method for the generation of coherent electromagnetic power at wavelengths from 1 to 2 mm through the excitation of a rectangular cavity by an electron beam is theoretically investigated by means of a field theory approach. Experimental studies at a wavelength of 7.55 mm that successfully demonstrate the method are described. A high-energy (1 Mev) bunched electron beam, produced by an S-band rebatron is used. The eleventh harmonic frequency component of the beam is used as a variable reactive element. The beam, when deflected by a tranverse field established by applied signal power, becomes an active element at a frequency equal to the sum of the beam harmonic frequency and the signal frequency. The power at this high frequency can be coupled out from the deflected beam by a fast-wave interaction between the periodic beam and a fast wave supported by a smooth structure. The essential difference between this frequency conversion technique and other beam harmonic frequency power coupling techniques is that the frequency of the output of the former can be variable and does not have to correspond to any harmonic frequency of the beam, where the frequency of the output of the latter must be one of the harmonics of the beam bunching frequency. Author

N64-26088 Westinghouse Electric Corp., Washington, D.C.
500 WATT SILICON POWER TRANSISTOR Quarterly Report, 31 Jan.–30 Apr. 1964
V. Balodis et al [1964] 34 p refs
(Contract NObsr-91001)
(QR-3; AD-600680)

Physical models, evaluation methods, and electrical measurements of secondary breakdown are presented. Design calculations and experimental results demonstrating high-voltage capability and feasibility of fabrication are discussed. A detailed encapsulation design is presented. Author

N64-26089 Westinghouse Electric Corp., Baltimore, Md. Westinghouse Defense and Space Center
STUDY OF FABRICATION OF MICROELECTRONIC ASSEMBLIES FOR FREQUENCY AND TIME CONTROL SYSTEMS. PHASE II: A FEASIBILITY MODEL OF A MICROMINIATURE VLF/LF FREQUENCY SYNTHESIZER Third Interim Development Report, 1 Jan.–31 Mar. 1964
G. R. Brainerd et al [1964] 42 p refs
(Contract NObsr-87593)
(MDE-3572; AD-600666)

The purpose of this contract is to design and fabricate a VLF/LF frequency synthesizer in microelectronic form. A single thread breadboard of this system was constructed and was successfully operated. A portion of the system was fabricated in thin film form and has performed as expected. Detailed specifications for the microelectronic circuits and interconnection of the circuits to formulate modues were prepared, and fabrication of the remaining microcircuits is in process. Author

N64-26095 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE EFFECT OF MISMATCHES ON THE CHARACTERISTICS OF AN O-TYPE BACKWARD-WAVE GENERATOR
L. V. Kasatkin and C. N. Rapoport 25 May 1964 20 p refs
Transl. into ENGLISH from Radiotekhn. i Elektronika (USSR), v. 8, no. 9, 1963 p 1577–1586
(FTD-TT-64-293/1+2+4; AD-602317)

By using the method of perturbations the effect of small mismatches on the characteristics of a backward-wave generator in the linear and nonlinear regimes was analyzed. Author

N64-26096 Litton Industries, San Carlos, Calif. Research Lab.
RESEARCH ON NOISE IN CROSSED-FIELD GUNS Quarterly Report, 1 Jan. –31 Mar. 1964
R. P. Wadhwa 20 Apr. 1964 32 p refs
(Contract NObsr-89546)
(QR-3; AD-600578)

The design criteria for the low-noise crossed-field amplifier are discussed. The assembly drawing of the device is given, and the various parts used in the device and their functions are discussed in detail. By selection of appropriate dimensions for the insulators which withstand the sole-anode voltage, and the BeO parts, which provide sufficient cooling for the losses, reasonably good insertion-loss characteristics can be achieved. In noise figure calculations, it is necessary to consider the propagation of all the waves; consideration of the growing wave only yields values of calculated noise figure less than those obtained by considering all the waves. This difference depends upon the gain of the amplifier. Author

N64-26125 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
OBTAINMENT OF NANOSECOND PULSES OF ULTRA-HIGH FREQUENCY OSCILLATIONS
S. I. Andreyev, V. M. Lebed', and B. M. Sokolov 12 Jun. 1964 5 p refs Transl. into ENGLISH from Pribory i Tekhn. Eksperim., No. 5 1963 p 123–124
(FTD-TT-64-472/1+2; AD-602333)

A method is described of obtaining UHF pulses with the aid of a broadband ferrite modulator. At a sinusoidal change in controlling magnetic field with amplitude exceeding 20 e, the modulator forms pulses with a power of electromagnetic oscillations of a frequency of 9.4 e, the length of which may vary from 10 to 400 nanoseconds. Author

N64-26175 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
PHASE RELATIONSHIPS IN PARAMETRIC AMPLIFIERS
Wesley G. Matthei Apr. 1964 23 p
(USAELRDL-TR-2451; AD-602650)

The purpose of this report is to present experimental evidence to show that the phase of the amplified signal in a three-frequency parametric amplifier is independent of the phase of the pump, while the phase of the idler varies directly with the phase of the pump. The experimental evidence is consistent with the theory of the parametric amplifier. Author

N64-26196 Weston Instruments, Inc., Newark, N.J.
A POROUS SUBSTRATE RESISTOR AIMED AT MINIATURIZATION OF METAL-FILM RESISTORS Interim Development Report, Mar.–31 May 1964
T. Matley and R. E. Busch [1964] 19 p
(Contract NObsr-87542)
(IDR-7; AD-602366)

Cut quartz and molded quartz substrates have been produced that show much greater structural uniformity than any other material previously evaluated. Accurate metallizing time has been established by evacuating substrates prior to immersion. The system is mechanically controlled. A new braze technique (direct braze method), which eliminates the fritted terminal, promotes complete coverage of the substrate-terminal interface during metallization. Author

N64-26203 Army Missile Command, Huntsville, Ala.
DESIGN AND DEVELOPMENT OF FLAT CABLE ELECTRICAL CONNECTORS Final Report
Charles E. Riley and Kenneth W. Plunkett 5 Sep. 1963 69 p
(RG-TR-63-25; AD-421566)

Four designs of flat cable connectors were evolved and evaluated. One of the four connector concepts was selected for further evaluation, pilot production, and environmental testing. Results of the environmental tests show basic deficiencies in the selected concept that require major design modifications. D.E.W.

N64-26249 Harry Diamond Labs., Washington, D.C.
TRANSIENT RADIATION EFFECTS ON BASIC TRIODE AMPLIFIERS
Paul A. Trimmer 24 Apr. 1964 37 p
(TR-1197; AD-600770)

Transient radiation-effects data on basic triode amplifiers were obtained for gamma radiation exposure rates varying from 1×10^5 to 1×10^7 r-sec^{-1}. The net effect of the interaction of nuclear radiation with the basic amplifiers is equivalent to introducing a current generator into the grid circuit. For a potted amplifier using a 12AX7 miniature tube with a plate potential of 250 v, this current is on the order of 5 to 8×10^{-13} amp-sec-r^{-1}. The neutron radiation, which accompanies the gamma radiation in a reactor, did not have any appreciable effect. The radiation facility and experimental techniques are discussed. Data are also given on leakage currents in the potting compound, glass envelope of the tube, mica spacers, and air. Author

N64-26315 Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
A TUNABLE TUNNEL-DIODE CONVERTER
R. G. Veltrop 8 May 1964 43 p refs
(Contract DA 36-039 AMC-03404(E))
(EDL-M666; AD-602758)

Mechanically tunable tunnel-diode converters were developed that cover the 1.0- to 6.0-Gc frequency range in four bands. Tunnel-diode oscillators are used with separate backward tunnel-diode mixers to achieve low noise figure performance that rivals conventional crystal mixers. The oscillators employ a novel cavity-stabilization technique to obtain a high degree of frequency stability with temperature, bias, and load variations. Design considerations and detailed performance characteristics are presented for an S-band tunnel-diode oscillator and an S-band backward tunnel-diode mixer. Author

N64-26323 Philco Corp., Lansdale, Pa.
RESEARCH AND DEVELOPMENT TO OBTAIN SEMICONDUCTOR JUNCTION MIXER DIODES FOR COUNTERMEASURES EQUIPMENT Third Interim Engineering Report, 1 Jan.–31 Mar. 1964
M. Davis et al [1964] 68 p refs
(Contract NObsr-89420)
(H-102; AD-600555)

Microplanar and micromesa tunnel diodes for X-band application were fabricated in both germanium and silicon. The most practical approach to the goal of low noise and high resistance to burnout is the germanium micromesa structure, modified to reduce the mesa to a height equal to the alloy depth in the microplanar structure. It is not inhibited by spreading on alloying and permits tailoring of the junction diameter. The germanium micromesa structure has unity noise-temperature ratio and a burnout resistance greater than 6 ergs, with over 20 ergs for many diodes. Noise figures of 8 to 9 db are readily attained. An aluminum-alloyed germanium micromesa

structure with thermocompression-bonded contacts promises a higher temperature operating capability and greater resistance to burnout. To reduce the peak current and capacitance, higher resistivity material, post-alloy diffusion, and dilution of the alloyed were tried individually; however, each caused an undesirable reduction in the peak-to-valley current ratio. Experiments with silicon included structures formed by local alloying, local epitaxial deposition, or alloying and etching. Rectification at X-band was indicated only for the micromesa structure formed by alloying and etching. A ridged waveguide-to-coaxial mount for 7 to 11 Gc broadband operation has been designed and fabricated. VSWR was designed at 1.2.
Author

N64-26374* New York U., N.Y. Lab. for Electroscience Research
A PRELIMINARY STUDY OF SINE WAVE PLUS NOISE FOR APPLICATION TO INSTRUMENTATION TAPE RECORDER PERTURBATIONS Technical Memorandum No. 36
Gerald Weiss 10 Mar. 1964 32 p refs
(Contract NAS5-3508)
(NASA-CR-58127) OTS: $3.60 ph

A model of a sine wave plus noise is presented to show the interrelationship between phase correlation, time displacement error, and power spectrum of instrument-type tape recorders. For small observation times, during which the output phase is highly correlated, the time displacement error increases directly with observation time. For large observation times, however, phase correlation no longer obtains, and time displacement error is constant with time. In addition, a knowledge of time displacement error is sufficient to determine the output power spectrum.
Author

N64-26376 Joint Publications Research Service, Washington, D.C.
TECHNICAL CYBERNETICS, NO. 2, 1964
19 Jun. 1964 304 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, OTN, Tekhn. Kibernetika, (Moscow), no. 2, Mar.–Apr. 1964 p 1–192
(JPRS-25-169; OTS-64-31521) OTS: $4.00

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N64-26383 Joint Publications Research Service, Washington, D.C.
AN ANALOG TO THE METHOD OF LOURIER FOR ANALYSIS OF STABILITY OF NON-LINEAR PULSE AUTOMATIC CONTROL SYSTEMS
G. G. Rakhimov *In its* Tech. Cybernetics 19 Jun. 1964 p 87–99 refs (See N64-26376 18-16) OTS: $4.00

The absolute stability is investigated for pulse automatic control systems with nonlinear characteristics that belong to a sector bounded by the abscissa and a straight line passing through the origin of the coordinates in the first and third quadrants. On the basis of the Lourier analog method criteria are obtained for absolute stability of pulse systems. Cases are investigated where the linear part of the pulse system has simple poles which are not zero and when one of the poles is zero. The approach discussed is illustrated by examples.
Author

N64-26384 Joint Publications Research Service, Washington, D.C.
ON THE SYNTHESIS OF CONTROL WHICH IS OPTIMUM WITH RESPECT TO RAPID ACTION

L. Ye. Kanarev *In its* Tech. Cybernetics 19 Jun. 1964 p 100–114 refs (See N64-26376 18-16) OTS: $4.00

A method is presented for synthesis of optimal control with respect to rapid action based on the construction of regions of the phase space in which the optimum control does not change sign. For some class of linear systems of the third order the solution of the problem of synthesis is obtained in general form. A method is also proposed for the construction of a switching surface for a class of systems of the n^{th} order. Author

N64-26385 Joint Publications Research Service, Washington, D.C.

GENERALIZATION OF THE PROBLEM OF SYNTHESIS OF A MULTICHANNEL DISCRETE-CONTINUOUS FILTER

V. Ya. Katkovnik *In its* Tech. Cybernetics 19 Jun. 1964 p 115–123 refs (See N64-26376 18-16) OTS: $4.00

The problem is investigated of synthesis of an optimal discrete-continuous filter in the case of noncophased closure of input switches. Expressions are presented for the spectral densities of the processes at the output of a similar system during the presence at the input of fixed random effects. Equations are derived for the determination of transfer functions of the optimal filter, and a method is indicated for their solution. Author

N64-26387 Joint Publications Research Service, Washington, D.C.

TRANSFORMATION OF A DISCRETE SYSTEM OF RANDOM SIGNALS GIVEN BY A CANONICAL EXPANSION

G. P. Molotkov *In its* Tech. Cybernetics 19 Jun. 1964 p 131–159 refs (See N64-26376 18-16) OTS: $4.00

The transformation of a linear discrete system of random signals is investigated in the cases where a digital correction circuit is located in the forward or reverse circuit. The necessity is demonstrated for the application of the theory of canonical expansions under the effect on the system of nonstationary input signals. Expressions are written out for the z-transformation of signal dispersion at the output under the effect on the system of both stationary and nonstationary input signals. An example is solved. Author

N64-26388 Joint Publications Research Service, Washington, D.C.

THE ALGORITHM OF THE PROBLEM OF DEFINITION OF OPTIMAL PARAMETERS OF CONTROL SYSTEMS BY THE GRADIENT METHOD

Yu. K. Kuznetsov, R. P. Sen'chenko, and V. I. Chernetskiy *In its* Tech. Cybernetics 19 Jun. 1964 p 140–152 refs (See N64-26376 18-16) OTS: $4.00

A numerical method is proposed for the definition of optimal parameters of control systems with respect to given differential equations that describe the processes in the object–control system. Recommendations are given with respect to evaluation of the step size and choice of method of integration of the initial system of equations. Possible methods are investigated for construction and calculation of a functional, which is the criterion for the quality of the control process. The problem of definition of parameters for which this functional achieves an extremum is solved by the gradient method. The proposed algorithm is suitable both for linear and nonlinear control systems. Author

N64-26391 Joint Publications Research Service, Washington, D.C.

ON A METHOD OF STABILIZATION OF A CONTROL SYSTEM WITH LIMITED PERMISSIBLE VALUES OF THE REGULATOR PARAMETERS

V. M. Badkov and Ye. A. Barbashin *In its* Tech. Cybernetics 19 Jun. 1964 p 184–197 refs (See N64-26376 18-16) OTS: $4.00

A control system of the third order is investigated with a variable structure. The problem is presented of stabilization of a system with limitation of the admissible values of the parameter of the regulator. Beginning with expressions of optimumness with respect to rapid action, it is proposed that a switching surface be constructed from two planes with a discontinuity in the coordinate plane $x = 0$. The desired quality of control is achieved by means of varying the character of the sliding region with motion of the point of phase space with respect to the switching surface. Author

N64-26392 Joint Publications Research Service, Washington, D.C.

SWITCHING CONDITIONS IN COMBINED TRACKING SYSTEMS OF VARIABLE STRUCTURE

Ye. B. Dudin *In its* Tech. Cybernetics 19 Jun. 1964 p 198–212 refs (See N64-26376 18-16) OTS: $4.00

A method is described for the selection of a switching hyperplane of a combined tracking system with variable structure. In an example, it is demonstrated by a tracking system with an object of second order that the selection of the region of existence of a sliding condition in the switching hyperplane of this system may be done separately depending on two factors–the position of the hyperplane (switching) in phase space and parameters of the closed cycle, and the form of the reproducible control effects and the parameters of the closed cycle. For a tracking system with an object of the second order the solution of the first of the indicated problems is considered. Author

N64-26393 Joint Publications Research Service, Washington, D.C.

ON STABILITY OF MOTION OF A CLASS OF AUTOMATIC CONTROL SYSTEMS WITH VARIABLE STRUCTURE

S. V. Yemel'yanov and V. I. Utkin *In its* Tech. Cybernetics 19 Jun. 1964 p 213–217 refs (See N64-26376 18-16) OTS: $4.00

Automatic control systems are investigated with variable structure of an arbitrary order. For a determinant class of these systems, stability of motion must be insured by an increase in the amplification coefficient of the closed system. Author

N64-26394 Joint Publications Research Service, Washington, D.C.

A SELF-TUNING SYSTEM WITH A MODEL II

I. N. Kritova and V. Yu. Rutkovskiy *In its* Tech. Cybernetics 19 Jun. 1964 p 218–231 refs (See N64-26376 18-16) OTS: $4.00

The general properties of a self-tuning system with a model standard are investigated. Algorithms are analyzed for the determination of mismatch errors and laws of formation of reconstructed coefficients. A self-tuning system with a pattern-standard has the properties of the system having astaticism of high order. Author

N64-26395 Joint Publications Research Service, Washington, D.C.

ON THE DESIGN OF AUTOMATIC CONTROL SYSTEMS CONTAINING NON-STATIONARY LINKS

G. I. Vanyurikhin *In its* Tech. Cybernetics 19 Jun. 1964 p 232–241 refs (See N64-26376 18-16) OTS: $4.00

For an approximate solution of the synthesis of a system containing a link with variable parameters, it is proposed to

freeze the weight function of this link at some point in time t_0 that reduces the system to stationary. The advantage of this method over the method of frozen coefficients is indicated. Author

N64-26397 Joint Publications Research Service, Washington, D.C.
A NEW MECHANICAL POWER AMPLIFIER
A. Ye. Kobrinskiy and A. I. Korendyasev *In its* Tech. Cybernetics 19 Jun. 1964 p 266–295 refs (See N64-26376 18-16) OTS: $4.00

The principle of operation and schematic diagram of a mechanical power amplifier are described. The kinetostatic analysis is made and the characteristics of the amplifier set up for its operation under so-called load and release conditions. The experimental setup and results of the experiment are described. Author

N64-26439 Advisory Group for Aeronautical Research and Development, Paris (France)
MICROPOWER ELECTRONICS
Edward Keonjian, ed. Oxford, N.Y., Pergamon, 1964 222 p refs
(AGARDOGRAPH-77) Pergamon: 84s

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N64-26440 Stanford U., Calif. Electronics Labs.
RELATIONS BETWEEN MINIMUM REQUIRED POWER DENSITY AND FREQUENCY RESPONSE FOR PRESENT AND FUTURE SEMICONDUCTOR TRIODE AMPLIFIERS
J. L. Moll *In* AGARD Micropower Electron. 1964 p 3–17 refs (See N64-26439 18-09) Pergamon: 84s

At low power densities the major limit on speed of response and frequency is emitter charging time for amplifiers that inject carriers as in the case of the bipolar transistor, space charge limited triode, etc. The limit on the field effect transistor is the gate charging time. The proper design of emitter for the bipolar amplifier (electrons and holes, or hot electrons and cold electrons) or the proper design for the gate of the field effect transistor results in essentially the same limit on required power density. The switching time in each case is determined by the time to charge a capacitor with a given current. Author

N64-26441 Princeton U., N.J.
PHYSICAL REALIZATION OF DIGITAL LOGIC CIRCUITS
Arthur W. Lo *In* AGARD Micropower Electron. 1964 p 19-39 (See N64-26439 18-09) Pergamon: 84s

This paper presents a unified concept on the requirements necessary to provide a common basis for evaluating the merits and limitations of the large variety of presently available and prospective digital devices and circuit techniques that are proposed for the implementation of practical low-power digital systems. Discussed are elementary digital networks, switching elements, and micropower operation. R.T.K.

N64-26442 Fairchild Semiconductor Corp., Mountain View, Calif.
METAL-OXIDE-SEMICONDUCTOR FIELD-EFFECT DEVICES FOR MICROPOWER LOGIC CIRCUITRY
G. E. Moore, C. T. Sah, and F. M. Wanlass *In* AGARD Micropower Electron. 1964 p 41–55 refs (See N64-26439 18-09) Pergamon: 84s

Circuitry based upon complementary polarity metal-oxide-semiconductor field-effect triodes shows considerable promise for digital applications where low standby power is required with high switching speeds. Laboratory samples of these device structures were used to make circuits with standby power of the order of nanowatts that will propagate signals with about 10 nsec delay. The circuitry form appears to be well suited for construction in integrated form to realize all the inherent advantages, although integration of the complementary structures has not yet been accomplished. Author

N64-26443* CBS Labs., Stamford, Conn.
MICROPOWER MICROELECTRONIC SUBSYSTEMS
W. W. Gaertner, M. Schuller, C. Heizman, and C. Levy *In* AGARD Micropower Electron. 1964 p 57–84 refs (See N64-26439 18-09)
(Partially sponsored by NASA) Pergamon: 84s

The microelectronic concept that has evolved during the past 3 years, and the performance achieved in micropower subsystems that have been built as a result of this concept, are described. The designs and technology developed permit the building of microelectronic subsystems of considerable complexity. These subsystems consume, by a factor of 100 to 1,000, less power than equivalent systems constructed with conventional components or any other available form of microelectronics. R.T.K.

N64-26444 Mullard Radio Valve Co., Ltd., Mitcham (Gt. Brit.) Microminiaturization Dept.
A MICROMINIATURE DIGITAL INTEGRATOR USING MICROPOWER CIRCUITS
A. T. Watts *In* AGARD Micropower Electron. 1964 p 85–103 refs (See N64-26439 18-09) Pergamon: 84s

The digital integrator described was chosen as a vehicle for proving the practicability and performance of systems built from thin-film microcircuits. The integrator circuit design, construction, and performance are discussed. R.T.K.

N64-26445 Semi-Conductors, Ltd., Geneva (Switzerland)
THE MULTIPLE EMITTER TRANSISTOR IN LOW POWER LOGIC CIRCUITS
B. A. Boulter *In* AGARD Micropower Electron. 1964 p 105–120 refs (See N64-26439 18-09) Pergamon: 84s

If an attempt is made to reduce the power dissipation of logic circuits incorporating resistance capacitance networks as transient stores and coupling elements, the speed of the circuit is limited by the time constant of the coupling elements rather than by the speed of the transistors. Consequently the system described does not use capacitors, the device speed being fully utilized in a circuit configuration that minimizes the power dissipation per logical connection. The use of silicon planar devices allows circuit operation at very low power levels, and in the circuits described, a multiple emitter transistor is used to provide the input functions required in a logical gate. The power dissipation is independent of the number of inputs to the gate, and by virtue of the direct-coupled mode—a voltage translation element—and the consequent steady state, power from a second bias supply is not required. Directly coupled to a saturating common emitter transistor, the multiple emitter transistor minimizes the leakage current effects in that transistor, enabling operation at lower current levels. Furthermore, the load presented to the output by similar circuits is such that no large standing collector current is required. Author

N64-26446 Computer Control Co., Inc., Framingham, Mass.
DESIGNING MINIMUM POWER DIGITAL CIRCUITS FOR MARINER II AND OTHER SPACECRAFTS
Robert C. Baron *In* AGARD Micropower Electron. 1964 p 121–151 refs (See N64-26439 18-09) Pergamon: 84s

This paper discusses some of the special factors encountered in the design of digital systems for space environment. Unique challenges are presented to the design engineer due to the requirements of ultrareliability, minimum power, weight, and volume, and environmental considerations including shock, vibration, temperature, and prolonged exposure to radiation and vacuum. These requirements present changes both of degree and of fundamental concept from those of the standard ground-based system. The circuitry used in the scientific data conditioning system on board the Mariner II spacecraft is described to illustrate one approach to the design of low power, high reliability equipment. The system controlled the sampling of all Mariner scientific experiments, prepared the data for transmission, and generated special instrumentation control and calibration signals. Several other circuits are discussed to indicate other sets of compromises made in the design of both spaceborne and ground-based systems. Some conclusions are drawn then to indicate possible trends in the design of spacecraft data-handling equipment, and the potential role of microelectronics in this area. Author

N64-26447 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
STATIC AND DYNAMIC PERFORMANCE OF MICROPOWER TRANSISTOR LINEAR AMPLIFIERS
J. D. Meindl, R. A. Gilson, O. Pitzalis, and W. Kiss *In* AGARD Micropower Electron. 1964 p 153–197 refs (See N64-26439 18-09) Pergamon: 84s

Silicon planar transistors that exhibit junction reverse currents smaller than 10^{-9} A and common emitter current transfer ratios greater than 50 for collector currents of 10^{-6} A are now available. An optimum design technique for the application of these devices in linear broadband amplifiers was devised. A salient feature of this technique is that it provides a unified approach to the d.c. and large signal a.c. design of a micropower amplifier. Subject to initial constraints, the design technique provides a specified amplifier output power capability over a wide temperature range, minimizes amplifier power drain, and maximizes amplifier power gain. With slight modification, the optimum design technique also serves as the basis for a worst case design procedure for linear amplifiers considering transistor and resistor tolerance margins. The frequency response of micropower amplifiers can be accurately predicted on the basis of a unilateralized hybrid pi transistor equivalent circuit. Amplifier bandwidth may be significantly enhanced with a cascode circuit. Using a simple thermistor temperature compensation technique, micropower amplifiers were designed whose gain and terminal impedances are virtually insensitive to large temperature changes. Author

N64-26455 Princeton U., N.J. Plasma Physics Lab.
AN INDUCTIVE ENERGY STORAGE SYSTEM USING IGNITRON SWITCHING
E. Simon and G. Bronner Apr. 1964 32 p refs
(Contract AT(30-1)-1238)
(MATT-264)

Previous work in the field of inductive energy storage and control is described. The need for a fast, reliable switch for the control of such systems is pointed out. A new inductive energy storage switching system that fulfills this need is described. Author

N64-26476* Martin Co., Baltimore, Md. Rias Div.
ON A NEW CHARACTERIZATION OF LINEAR PASSIVE SYSTEMS
R. E. Kalman Apr. 1964 26 p refs Submitted for Publication
(Contracts NASw-718; AF 33(657)-8559; AF 49(638)-1206)
(TR-64-7)

The dynamical equations of an *N*-port are derived; a characterization theorem is proposed; the restrictions imposed by passivity and/or reciprocity on the matrices *F*, *G*, and *H* (constant linear transformation) are determined; and the relation between the impedance *Z* and the state variable description of an *N*-port is stated. This study indicates the following: (1) Methods based on the impedance concept are coordinate-free. They do not display directly the structural properties of the realization. (2) State-variable methods, on the other hand, are closely related to the structural properties of networks. (3) Every transfer-function matrix admits realizations. Some of these realizations may correspond to networks, while others may require active elements (analog computers). (4) Nonnegative real impedance matrices always admit passive realizations, i.e., realizations impose restrictions on *F*, *G*, *H*, *P*, *Q* in addition to those implied by passivity. In all cases where these matrices are known, they are expressible in terms of the impedance matrix. I.v.L

N64-26491 Naval Ordnance Lab., Corona, Calif. Missile Systems Dept.
MEASUREMENTS OF SILICON PHOTODIODE CHARACTERISTICS UNDER BACKGROUND RADIATION CONDITIONS
C. M. Kaloi 1 Mar. 1964 44 p refs
(NOLC-595; AD-600032)

The performance characteristics of the silicon photodiode under different background conditions are evaluated experimentally and, to a lesser degree, analytically. The performance characteristics investigated are responsivity, frequency response (time constant), noise-equivalent power, spectral response, and dynamic impedance. In the tests, these characteristics were measured with the diode subjected to direct sunlight and to various levels of simulated sunlight. Author

N64-26495 Sylvania Electric Products, Inc., Woburn, Mass. Semiconductor Div.
PRODUCTION ENGINEERING MEASURE FOR GALLIUM ARSENIDE VARACTOR DIODE Quarterly Progress Report, Dec. 1, 1963–Feb. 29, 1964
C. F. Davis, Jr. [1964] 69 p
(Contract DA-36-039-SC-86736)
(QPR-7; AD-437167)

Preproduction gallium arsenide varactor diodes were tested to specification SCS-128 amendment 2 dated 29 October 1963. Two units failed. Analysis indicated certain remedial steps, which were taken. Process and parts modifications are described and justified. Material and parts are being finalized for pilot production. Author

N64-26506 Bell Telephone Labs., Inc., New York, N.Y.
ENGINEERING SERVICES ON TRANSISTORS Third Quarterly Progress Report, 1 Oct. – 31 Dec. 1963
J. J. Chang, D. J. D'Stefan, R. Edwards, J. E. Iwersen, J. Kocsis et al 30 Mar. 1964 76 p
(Contract DA-36-039-AMC-02227(E))
(Rept.-14; AD-600099)

Research effort is reported on the following tasks: (1) new and improved transmission-type transistors—status of the 6-gigacycle germanium transistor, and special mounting of high-frequency planar transistor wafers; and (2) functional devices and integrated circuits—an exercise in high-speed real-system integration, and a silicon mosaic for integrated devices. R.T.K.

N64-26511 Microwave Associates, Inc., Burlington, Mass.
X-BAND SOLID-STATE DETECTOR/AMPLIFIER Quarterly Progress Report, 1 Oct. – 31 Dec. 1963
John J. Brule [1964] 44 p refs
(Contract DA-36-039-AMC-03274(E))
(QPR-2; AD-600279)

Progress was made in the evaluation of several possible components and techniques that could be integrated into a miniaturized solid-state x-band detector amplifier. The major emphasis was placed on determining the pertinent characteristics of each component and evaluating its applicability to the program objectives. Two approaches to the design of a suitable mixer were evaluated. Measurements performed on a single-ended mixer employing a backward diode indicated that noise figures of about 9.0 db could be obtained with this technique. Attention in the area of I.F. preamplifiers was focused on the design, fabrication, and test of an I.F. parametric amplifier circuit and evaluating solid-state preamplifier performance. Author

N64-26513 Ibrape, S. A. (Brazil) Electronics Application Lab.
ADDER AND SUBTRACTOR TRANSISTORIZED DECIMAL COUNTER WITH INDICATOR TUBE ZM1040/Z522M
Jayme Kopelman Oct. 1963 21 p
(BI-032)

This report describes the circuit of an adding and subtracting transistorized decimal counter with type ZM1040/Z522M indicating tube. It shows the working principle, and the method of design. The counting direction is determined by a mechanical or by an electronic switch. The maximum frequency of the input pulses is about 5,500 pps. Author

N64-26514 Ibrape, S. A. (Brazil) Electronics Application Lab.
A TRANSISTOR CHOPPER FOR LOW LEVEL DC SIGNALS Addendum to Report BI-021
Samuel K. Konishi 22 Feb. 1963 17 p
(BI-026)

This addendum refers to the transient suppressor circuit of the previously published report. A circuit is presented to correct the a.c. output voltage waveform of the transistor chopper to a square wave signal. This circuit can be used in other electronic applications, although its large stabilization time is a disadvantage. D.S.G.

N64-26525 Utah U., Salt Lake City Microwave Devices Lab.
CYCLOTRON WAVE DEVICES STUDY Second Quarterly Progress Report, Oct. 1–Dec. 31, 1963
T. Kao, D. C. Watson, C. H. Durney, C. C. Johnson, and R. W. Grow [1963] 17 p
(Contract DA-36-039-AMC-02372)
(Rept.-2; AD-600559)

The S-band amplifier was tested during this quarter. Good coupling to the beam was obtained by the use of double-stub tuners. The small-signal gain was low and appears to be sensitive to the d.c. focusing conditions. The coupled-mode analysis, modified to account for space-charge and beam rotation, showed that the coupling is quite complex, involving several cyclotron and synchronous idlers and longitudinal velocity and displacement modes. Author

N64-26557 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
SEMICONDUCTOR SWITCHING AND LIMITING USING 3 DB SHORT SLOT (HYBRID) COUPLERS
V. J. Higgins Jan. 1964 14 p refs
(USAELRDL-TR-2409; AD-600028)

This report describes an X-band shunt mode semiconductor switch and limiter using silver-bonded germanium varactors and 3-db short slot (hybrid) couplers. When the balanced arms of a 3-db short slot coupler are terminated in perfectly matched loads, the output arm will be thoroughly isolated from the input arm; when the balanced arms are short circuited, the output arm will be directly coupled to the input arm with little or no loss. Voltage dependent variations in the impedance level of silver-bonded diodes are used to switch between matched and mismatched conditions providing isolation or low insertion loss. Details of an externally biased semiconductor switch and a passive power limiter are included. Author

N64-26559 European Organization for Nuclear Research, Geneva (Switzerland) MSC Div.
RF BROAD-BAND AMPLIFIERS FOR DRIVING REACTING LOADS
A. Fiebig 4 Jun. 1964 56 p refs
(CERN-64-27)

Some methods for coupling capacitive loads to valve amplifiers are discussed. For comparing their efficiencies a quantity called reference power is defined. This is given as the product of either the maximum or the average current and the maximum voltage in the desired frequency band. This number determines the necessary voltage and current, and also, to some extent, the power rating of the driving valve and the necessary d.c. power. A distinction is made between low-Q and high-Q bandfilter coupling technique. From the maximum ratings point of view, the high-Q technique is preferable. Another coupling technique is discussed, using the characteristics of a classical bandpass filter chain. This yields equal or more favorable results than a three-circuit bandfilter, but needs more coupling network elements. Author

N64-26563 Naval Ordnance Lab., White Oak, Md.
RF DESENSITIZED SWITCH
Richard J. Sanford Jun. 1964 14 p
(NOLTR-64-43; AD-600338)

The RF desensitized switch is a p-n-p-n switch especially designed to be insensitive to radiofrequency energy. This insensitivity results from an abnormally large gate RC time constant and from the use of a zener diode to apply a desensitizing bias in the presence of RF energy. The device is diffused into a silicon chip that may then be mounted in a number of different packages for a wide range of sizes and power capabilities. Author

N64-26564 Ibrape, S. A. (Brazil) Electronics Application Lab.
CONVERTER FOR TESTING TV SOUND I.F. AMPLIFIER
Oswaldo Kaguiya 14 Feb. 1964 14 p
(BI-031)

The converter described in this report is one equipment for testing TV sound IF amplifier. It converts the frequency of 57 mc/s modulated with AM or FM into 4.5 mc/s modulated in AM or FM, respectively. The 57 mc/s signal is obtained from an AM–FM signal generator. Author

N64-26566 Ibrape, S. A. (Brazil) Electronics Application Lab.
MAXIMALLY FLAT GROUP-TIME DELAY AMPLIFIER
Luiz Peregrino da Silva, Jr. 28 Jan. 1963 16 p
(BI-025)

This paper presents the ideal amplifier and an approximation to constant group-time delay using Bessel polynomials. Data are provided to compute amplifier gain using this type of approximation. Author

N64-26607 Stanford U., Calif. Stanford Linear Accelerator Center
A PULSED BENDING MAGNET FOR THE BEAM SWITCHYARD AREA OF THE STANFORD TWO-MILE LINEAR ELECTRON ACCELERATOR
H. Brechna May 1964 88 p refs
(Contract AT(04-3)-400)
(SLAC-28) OTS: $2.00

This paper presents the results of detailed calculations and the design of a switching or pulsed magnet. The magnet has a laminated H-type core and a multistranded water-cooled coil, and is suitable for bending an electron beam of 25 Gev/c an angle of $\pm 0.5°$. The switching magnet is located in the beam switchyard area of the Stanford 2-mile linear accelerator. Problems concerning the laminated core and the multistranded coil, the a.c. losses, the temperature rise, and the effect of pole shaping on field homogeneity in the gap are treated. The design parameters of an inductive load to be used in connection with the pulsed magnet are given in brief. The noise level and the core losses for the magnet are calculated. The design of the magnet for an energy level of 25 Gev/c electron may seem conservative, but it was determined that the magnets should also work for an energy of 40 Gev/c electrons representing a later stage of the linear accelerator operation. Author

N64-26625 Du Pont de Nemours (E.I) and Co., Aiken, S.C. Savannah River Lab.
A VERSATILE ELECTRONIC TRIP DEVICE
William J. Woodward Jun. 1964 8 p
(Contract AT(07-2)-1)
(DP-897) OTS: $0.50

A simple alarm trip unit was designed to operate from the recorder output voltage from a micro-microammeter without affecting recorders connected to the same terminals. The unit has a constant-gain amplifier for millivolt signals, direct connections for higher level signals, a meter with a manually set trip contact, and fail-safe relay circuitry to operate associated reactor scram circuits. Author

N64-26651 Harry Diamond Labs., Washington, D.C.
AN ALL-SEMICONDUCTOR COMMUTATOR
Robert Goings 15 Oct. 1963 26 p
(TR-1149; AD-437869)

A 16-channel all-seciconductor commutator was designed and field tested in the T361, T368, XM112, and TOW missile-telemetry systems. Of approximately 200 electronic units tested, all performed satisractorily under accelerations up to 14,000 g and 180 rps. The design concept is based on a code-operated multiposition switch that is controlled by pulse and digital circuitry. For any switch configuration, only one input signal reaches the output terminal because of the AND gates. The binaries, therefore, change states and commutate from one channel to another with the generation of each input pulse. Theoretical details of the design and operation of the commutator are described and illustrated. Author

N64-26654 Boeing Co., Seattle, Wash.
CORRELATION OF PROTON TO NEUTRON AND ELECTRON TO PHOTON RADIATION DAMAGE IN TRANSISTORS AND DIODES
G. L. Keister 22 Apr. 1963 21 p refs
(D2-90407; AD-437754)

The correlation between proton, neutron, electron, and photon radiation damage in semiconductor devices is discussed, and the equivalence of radiation damage was studied. Semiconductor devices were used in the study, since they have the lowest threshold to displacement-damage effects. In the investigation of radiation effects on semiconductor materials, the quantities of interest were the minority carrier lifetimes and carrier removal rates that affect the operation of solar cells, transistors, and some diodes. R.T.K.

N64-26668 Radio Corp., of America, Camden, N.J. Communications Systems Div.
INTRODUCTION TO THE DESIGN AND APPLICATION OF MICROMODULES
Sep. 1963 144 p
(Contract DA-36-039-SC-75968)
(AD-437877)

This design guide comprises the following: (1) the micromodule concept—a general description of the micromodule configuration and its attendant advantages; (2) micromodule design principles—specifications and design geometry of available microelements, design and layout procedures for micromodules, and a list of demonstrated micromodule circuits; (3) the construction of experimental micromodules—tools and techniques for the construction of breadboard circuits and experimental and production micromodules; (4) procurement specifications—procurement procedures and applicable MIL specifications for microelements and micromodules; (5) tools and procedures for assembly, testing, and servicing of micromodular equipment; and (6) micromodule applications—micromodular design techniques applied to military electronic equipment. The appendixes present a glossary of terms and discussions of microelement capability and of the performance specifications of representative micromodules. I.v.L

N64-26715 Texas Instruments, Inc., Dallas
MANUAL FOR POLYMODAL VOCODER, VOLUME II. SECTION V: DRAWINGS Final Report—Part Two
Aug. 1963 233 p
(HB18-A63; AFCRL-63-301, Pt. 2; AD-437624)

This manual contains circuit-board layouts and electronic and logic drawings for the circuits in the vocoder. Schematic drawings for the switches and jacks are also included. I.v.L.

N64-26724 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
JOURNAL FOR MEASUREMENT, CONTROL, AND REGULATION (AUTOMATION) Selected Articles
12 Aug. 1963 46 p refs Transl. into ENGLISH from Z. Fuer Messen Steuern Regeln (W. Germany), no. 7, 1962 p 299–305, 411–317
(FTD-TT-63-409/1+2; AD-416782)

CONTENTS:

1. EXAMINATION OF SOME TIME-OPTIMAL CONTROL SYSTEMS OF THE 2ND ORDER U. Engmann p 1–21 refs

2. METHODS FOR THE AUTOMATIC OPTIMIZATION OF CONTROL CIRCUITS R. Schaebitz p 22–41 refs

N64-26730 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
BEHAVIOR OF CATHODE SPOTS IN A HIGH-CURRENT ELECTRIC DISCHARGE
V. Grakov and V. Hermoch 28 May 1964 17 p refs Transl. into ENGLISH from Chekhoslovatskiy Fiz. Zh. (Prague), v. 13, no. 7, 1963 p 509–517
(FTD-TT-64-152/1+2+4; AD-602343)

Investigation of a high-current single discharge at atmospheric pressure demonstrated the existence of cathode spots of two types. The first type were characterized by a high rate of motion toward fresh sections of the electrode and formed on all types of metals. The second type had low mobility and formed only on metals with low values of thermophysical constants in places of local cathode boiling. R.T.K.

N64-26741 Microwave Associates, Inc., Burlington, Mass.
BROADBAND SOLID-STATE SWITCHES Quarterly Report, 1 Jan.–31 Mar. 1964
R. Tenenholtz [1964] 21 p
(Contract NObsr-89463)
(QR-3; AD-600290)

An analysis is presented on high power capability of broadband PIN diode switches and means of scaling performance from low power prototype designs. In addition, two basic broadband designs are described. Experimental data presented deal with blocking capacitor, d.c. return, and bias T designs suitable for use over the 7- to 11- Gc range. In addition, an improved insulated diode mount is described along with recent broadband high power performance at X-band on a prototype switch design. Author

N64-26747 Ion Physics Corp., Burlington, Mass.
ELECTROSTATIC POWER GENERATOR Quarterly Technical Progress Report, 15 Jan.–15 Apr. 1964
C. N. Coenraads [1964] 64 p refs
(Contract AF 33(615)-1168)
(QTPR-2; AD-600119)

Progress reported includes the following: (1) The generator system was completely rebuilt. The atmosphere-to-vacuum seal was designed and fabricated. (2) A milestone in the program was reached by the successful insulation of 35 kv between two 1,000 cm^2 electrodes with a 1-mm separation. Further insulation studies had led to a deeper insight into the basic vacuum insulation problem. (3) The study of excitation methods for the generator has led to a successful scale-model test. I.v.L.

N64-26764 Honeywell, Minneapolis, Minn. Aeronautical Div.
PARAMETER ESTIMATION IN NOISY SYSTEMS
V. S. Levadi 6 May 1964 27 p refs
(M-207; AD-600174)

Various techniques have been proposed for estimating either the system weighing function or the coefficients of the differential equation in parameter estimation. When uncertainty or noise appears in the measurements, the difficulty of obtaining a useful parameter estimate increases many times. With this in mind, a class of iterative procedures for estimating the parameters of a linear dynamic system was examined. The presence of measurement noise other than the noise in the measured state of the system is shown to produce a biased estimate of the parameters. The nature of this bias is determined by the covariance matrices of the state vector and noise vector. The model technique for eliminating the bias is a form of two-stage iterative procedure. The noisy measurements y are used to obtain the estimate $\hat{a}$. This parameter $\hat{a}$ is used in the model system to estimate the state x and the noise z. If the adjustment rate of the parameter $\hat{a}$ in the model is sufficiently slow, this later stage is comparable to computing the bias from an equation in which convariance the matrices R_{xx} and R_{zz} are computed from the estimates of x and z. The bias correction process is stable at equilibrium under the assumption of slow change in $\hat{a}$. I.v.L.

N64-26803 General Electric Co., Oklahoma City, Okla. Military Communications Dept.
SURFACE EFFECTS OF RADIATION ON TRANSISTORS
J. G. Woodruff 26 Feb. 1964 57 p refs
(R64MCD500)

Ionizing radiation produces surface effects of a serious nature in certain transistors. These effects include large increases in leakage current, changes in gain, and increases in noise. Data in this report show the effects of dose, dose rate, bias, environment, and surface protection on various transistors. The phenomena of recovery, memory, and reciprocity are also described. Surface effects become apparent at radiation does of 10^3 to 10^6 rads, depending on the gas inside the transistor envelope and the treatment of the surface prior to encapsulation. Author

N64-26821 Lockheed Missiles and Space Co., Sunnyvale, Calif.
PACKAGING AND INTERCONNECTIONS FOR MINIATURIZED ELECTRONIC SYSTEMS: AN ANNOTATED BIBLIOGRAPHY
Helen B. Mc Cormick, comp. Jun. 1963 238 p refs
(Contract NOrd-17017)
(SB-63-51; Rept.-3-80-63-4; AD-443450)

Overall aspects of microelectronics packaging are reported, with special emphasis upon welded interconnections, upon failure modes, and reliability testing. Possibilities for maintenance and repair are noted, such as repair of printed circuits, exact matching of encapsulating compounds, plug-in modules, especially designed connectors, and other devices for repair of a single component, wiring lead, or wafer without the necessity for discarding the unit package. The bibliography is in three major parts, with the individual abstract arrangement alphabetical by author or corporate source within the subject categories for each of the major sections. Numbering is in sequence

for the entire bibliography (599 refs). Separate indexes are provided for personal and for corporate authors, with the individual abstracts referred to by item numbers rather than by pages. Welded interconnections are dealt with; techniques for forming these connections; advantages over soldered connections; possibilities for welded connections in thin film or integrated circuits. Packaging and production problems are treated against the background discussion of microminiaturization and microcircuitry—theories, trends, comparisons, potential. Failure modes and reliability testing, with test data and evaluations of specific techniques and equipment, are given. Author

N64-26842 California U., Livermore Lawrence Radiation Lab.
LOOP CURRENTS IN A SYSTEM OF INDUCTIVELY COUPLED, SEQUENTIALLY ENERGIZED AND CROWBARRED COILS
R. E. Eillis 19 May 1964 46 p ref
(Contract W-7405-ENG-48)
(UCRL-7864) OTS: $1.00

A computer program, designated M-PULSE, designed for use on the IBM 7090, was developed to compute the loop currents, as a function of time, in a circuit consisting of up to 14 inductively coupled loops. A loop may typically consist of a pulsed coil and its associated capacitor bank (RLC loop), or the shielding for a d.c. coil (RL loop). Loops may be energized or crowbarred in sequence (when crowbarred an RLC loop becomes an RL loop). The program is specifically designed for use in calculating the currents in the pulsed coils of a plasma fusion device. Author

N64-26851 Illinois U., Urbana
PHASE PLANE THEORY OF TRANSISTOR BISTABLE CIRCUITS
Sergio Telles Ribeiro (Ph.D. Thesis) 6 Jun. 1963 220 p refs
(Contract Nonr-1834(15))
(Rept.-137; AD-410225)

The purpose of this investigation was to describe in detail the operation of transistor flipflops from a mathematical point of view, and to devise, based on this mathematical description, practical methods of analysis, design, and optimization of these flipflops. The mathematical description was accomplished with the establishment of general flipflop equations for the asymmetric case, the symmetric Eccles–Jordan case, and for the general nonsymmetric Eccles–Jordan flipflop and with the establishment of those qualitative aspects of their piecewise linear approximations—equations that clearly apply to the original system. Methods of analysis and design were devised by means of a detailed study on the phase plane of these piecewise linear equations, taken as approximations to the original nonlinear equations. The singularities of the system, the conditions for their existence, and the dependence of their nature upon the system parameters, as well as the phase plane portrait, are described. Based on the above study, some engineering methods of analysis and design are described, and some simplified formulas for the rapid estimate of flipflop behavior are presented. I.v.L.

N64-26862 Westinghouse Electric Corp., Elmira, N.Y. Electronic Tube Div.
APPLICATION OF LIGHT AND IMAGE INTENSIFICATION Monthly Technical Engineering Report No. 6, 1–31 Dec. 1963
Z. Szepesi and W. A. Thornton 13 Jan. 1963 7 p
(Contract N61339-1440)
(MTER-6; AD-603526)

Formulas were derived for the contrast (gamma) of the image intensifier and calculated on the computer. Spectral analysis of high purity CdSe powder of different origin was made. Different baking schedules for doping the powder resulted in more sensitive and more homogeneous layers. These powders gave fairly good sensitivities in plastic embedment too, when no further high temperature baking is necessary. Several image intensifier panels were built with both sintered and plastic embedded PC layers. Work started in constructing the high resolution image intensifier, using evaporated EL films. Work on the preparation of evaporated EL films was continued. Iodine and gallium coactivators were used besides chlorine. Neither brightness nor efficiency showed any dependence on the coactivators. Author

N64-26890 Litton Industries, San Carlos, Calif. Electron Tube Div.
HIGH-POWER CROSSED-FIELD AMPLIFIER Interim Technical Note
G. Kooyers, P. Hess, and R. Cougoule 30 Mar. 1964 90 p ref
(Contract AF 30(602)-2792)
(RADC-TDR-64-156; AD-603184)

Progress to date on the subject contract is fully discussed. The complete electrical and mechanical designs of both the interim and the final full specification tube are given. The RF design of the slow-wave structures and the input and output waveguide to slow-wave structure transitions are given, and detailed thermal dissipation calculations are presented. Results obtained on the test of the first interim tube are presented, and the conclusions and changes dictated by this test are given. A complete description of the necessary test facilities and auxiliary test equipment is given. Author

N64-26921 Michigan U., Ann Arbor Electron Physics Lab.
INVESTIGATION OF LARGE-SIGNAL TRAVELING-WAVE TUBES Quarterly Progress Report No. 7, 1 Jan.–31 Mar. 1964
G. T. Konrad; J. E. Rowe et al Griffiss AFB, N.Y., RADC, Jul. 1964 88 p refs
(Contract AF 30(602)-2834)
(RADC-TDR-64-231; AD-603280)

The two-dimensional analysis for large-signal phenomena in traveling-wave tubes and klystrons is employed to obtain solutions to hollow-beam TWA interactions and to biased-gap klystrons as well as distributed interaction klystrons. Computer results on the former are presented. A method to deal with the circuit equations in the nonlinear theory of multistream microwave devices is found. Also, the situation in which the electrons have an average drift velocity in addition to their thermal velocities is treated. Two helix-type phase-focused tubes were tested. The one utilizing two velocity jumps of 25% each yielded an improvement factor of 1.43 in the efficiency whereas the one with a 40% linear taper yielded an improvement factor of 1.30. The ring-and-bar tube using a uniform helix yielded values of small-signal electronic gain in the range of 10 to 18 db. A digital computer program for the solution of magnetron injection guns is developed and is nearly ready for use. Experimental data on a magnetron injection gun built some time ago and checked previously were tested under more optimum conditions. Author

N64-26958 Remington Rand Univac, Blue Bell, Pa.
INVESTIGATION OF FAULT DIAGNOSIS BY COMPUTATIONAL METHODS Technical Documentary Report, 1 Dec. 1963–1 Jun. 1964

L. Buchsbaum, M. Dunning, T. J. B. Hannom, and L. Mah
Wright-Patterson AFB, Ohio. AF Aero Propulsion Lab., May 1964 234 p refs
(Contract AF 33(657)-10113)
(APL-TDR-64-62; AD-601204)

The purpose of this contract was to formulate computational techniques for automatically isolating faults in electronic circuitry to the component level and to implement the technique utilizing a digital computer. The technique can be applied to linear circuits and to circuits containing small nonlinearities. The technique formulated uses circuit equations and represents an advance in the state-of-the-art from the conventional, sequential, go/no-go, automatic checkout techniques. All circuit equations used in the diagnosis are generated numerically by the computer from the specification of the circuit schematic in coded form and from the nominal values of all circuit components. Three diagnostic techniques are included. They involve the numerical network admittances that are automatically generated from the coded schematic. The required number of test terminals is minimal. Author

10 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands and wind tunnels); test ranges; and tracking stations. *For related information see*: 06 Auxiliary Systems.

N64-26103 Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
ULTRA-HIGH VACUUM VALVE STUDY
T.S. James, G. J. Reiling, and J. C. Murphy Arnold Eng. Develop. Center, Jul. 1964 164 p refs
(Contract AF 40(600)-991)
(PDM-12077A; AEDC-TDR-64-164; AD-443034)

A study was undertaken to develop a 48-in.-diam ultrahigh vacuum valve for use in the diffusion pumping system of a large space environmental chamber. To make a choice for the main seal a literature search was made, and various types of seals were analyzed, leading to the selection of several seals for testing. Mechanical and vacuum tests performed on seal test plates resulted in the development of a knife-edge–lead-groove seal, which was leak-free under ultrahigh vacuum conditions. Of several valve concepts developed, two were chosen for design. One, a swing-gate straight-through valve, was fabricated as a prototype and tested under actual operating conditions. The tests indicated that the prototype valve is capable of sealing a pressure of 1×10^{-9} mm Hg against full atmospheric pressure, with minimum leak rates lower than 7.32×10^{-11} atm-cc/sec. Fifty open–close operations did not adversely affect the functioning of the valve. Author

N64-26252 Lockheed Missiles and Space Co., Sunnyvale, Calif.
APPLICATION OF MOBILE DRYDOCK LAUNCH SYSTEM TO SPACE MISSIONS Final Report
25 Nov. 1963 47 p Prepared Jointly with Puget Sound Bridge and Dry Dock Co., Holmes and Narver, Inc., and Crandall Dry Dock Engr., Inc.
(Contract NBy-45852)
(LMSC-BO86121-1; AD-439718)

This volume summarizes the investigation and evaluation of semimobile drydock launch systems applied to the launching of space missions. It presents briefly the objectives, scope, technical approach, and concepts that were developed under the study for launching Atlas, Titan, and Saturn class space vehicles from semimobile drydock launch platforms at remote equatorial sites, or offshore the Atlantic Missile Range (AMR), or the Pacific Missile Range (PMR). It also indicates conclusions and recommendations for further study. Author

N64-26368* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
APOLLO COMMAND MODULE ACCESS ARMS, SATURN IB, LAUNCH COMPLEXES, 34 AND 37 Engineering Report
E. E. Chapple 15 May 1964 453 p
(NASA-TM-X-51843) OTS: $23.50 ph

Changes were made in the design of the Apollo Command Module Access Arms, Saturn IB, Launch Complexes 34 and 37. The basic truss and the spacer trusses are made of aluminum and have the same cross section. Fiber glass has been rejected in favor of aluminum for the environmental chamber. The hydraulic rotary actuator used on Complexes 34 and 37 is of the vane type, weighs approximately 600 lbs, and is mounted in pairs in tandem. The service structure for Complex 37 is equipped with silo gates and work platforms for the swing arms; the service structure for Complex 34 has no silo gates, but is furnished with enclosed adjustable work platforms. Both service structures are mobile. R.T.K.

N64-26426 Naval Research Lab., Washington, D.C.
MATERIAL IDENTIFICATION (SORTING)
Irwin Vigness May 1964 13 p refs
(AD-439601)

Present techniques of material sorting and identification are reviewed. These techniques are eddy current, ultrasonic, thermoconductivity, thermoelectric, hardness tests, stress–strain relations, magnetic, chemical (spot checks and etching), spark testing, direct electrical conductivity, density, and triboelectricity. The general principles and usefulness of these methods are described, and additional research and development work that would be of value in this field is discussed. I.v.L.

N64-26466 Federal Aviation Agency, Atlantic City, N.J. Systems Research and Development Service
EVALUATION OF THE EFFECTS OF AIR TRAFFIC OPERATING AT SEVERAL PROPOSED JETPORTS UPON THE AIR TRAFFIC CONTROL SYSTEM Final Report
H. Slattery, D. Bottomley, G. Jolitz, H. Rohland, and S. Rossiter May 1963 157 p

A new jetport was proposed to serve the New York metropolitan area, to be operational by 1968. A study was made of the effects of this proposed jetport on the air traffic control system, using the Model B Dynamic Simulator for air traffic control studies, and also using automatic data processing facilities for a traffic flow pattern analysis. Three proposed sites were submitted for evaluation. FAA was responsible for the development of the basic plans for airway structures and traffic flow patterns for each site studied. One basic route structure and traffic flow pattern was evaluated for each site condition. Modifications were made during exploratory runs to improve flows and procedures. The air traffic control problems generated by any of the three jetport sites would be complex and would generally arise due to crossings of heavily used arrival and departure routes with those of the other major airports in the area. The airspace requirements for handling the traffic flows for any of the three sites would necessitate changes to the

boundaries of established warning and restricted areas, or jurisdiction of airspace of other control facilities. The traffic flow pattern analysis indicated there would be no overall appreciable differences in the demand upon the system by air traffic under the various site conditions. Author

N64-26521 Aeronautical Research Council (Gt. Brit.)
A SIMPLIFIED APPROACH TO THE PHENOMENON OF WIND-TUNNEL RESONANCE
W. E. A. Acum (Natl. Phys. Lab.) London, HMSO, 1964 11 p refs
(ARC-R&M-3371; Supersedes NPL-AERO-1012, ARC-23717) HMSO: 5s

The resonance frequency for compressible flow past an oscillating model in a wind tunnel is obtained by considering the airstream as one part of the resonating system. This approach then gives the same frequencies as those previously obtained by image methods, and then applied to the rectangular tunnel with slotted roof and floor for which it is concluded that the resonance frequency is increased by having slotted walls. Author

N64-26537 National Aeronautical Lab., Bangalore (India)
THE UNITARY COMPRESSOR-DRYER SYSTEM OF THE WIND TUNNEL CENTRE OF THE NATIONAL AERONAUTICAL LABORATORY
M. L. R. Murthy, C. T. Madappa, V. Kalyanarama, and Y. V. G. Acharya Jul. 1963 99 p
(NAL-TN-AE-19-63)

Two centrifugal compressors driven by slip ring induction motors serve to supply 20,000 ft^3 of free air/min at 160 psig. A dual-type air dryer of sufficient capacity insures continuous supply of dry compressed air for the aerodynamic facilities. A water treatment and cooling plant handles the circulating water necessary for cooling the compressor-dryer equipment. A 5,000-kw substation supplies power to the compressor motors and other installations at the Center. The equipment and connected maintenance shops and stores are housed in one building. Author

N64-26562 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
TECHNIQUE FOR SEVERE RADIATIVE AND CONVECTIVE HEATING ENVIRONMENTS FOR MATERIALS EVALUATION
N. S. Diaconis, H. E. Weber, and W. R. Warren, Jr. Mar. 1964 65 p refs Presented at the 3rd Hypervelocity Techniques Symposium, Denver, Mar. 17–18, 1964
(Contract AF 04(694)-222)
(R64SD24; AD-600021)

A test technique is described for the study of the performance of heat protection materials for advanced atmospheric entry vehicles. A primary characteristic of the facility is the establishment of relatively severe test environments that simulate flight conditions in terms of gas composition, stagnation enthalpy, convective and radiative heat-transfer rates, and material specimen response. Another important feature is the significant flexibility in test variables that can be achieved. Author

N64-26575* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SIMULATOR REQUIREMENTS DEDUCED FROM COMPARISONS OF PILOT'S PERFORMANCE IN GROUND SIMULATORS AND IN AIRCRAFT
Lawrence A. Clousing N.Y., AIAA [1964] 12 p refs Presented at Fourth Congr. of Intern. Council of the Aeron. Sci., Paris, 24–28 Aug. 1964
(AIAA Paper-64-554) AIAA: 3 Fr. Fr.

Research experiences with piloted, ground-based simulators and comparisons with flight results are reviewed. Three specific research investigations are reported—jet transport landings, takeoff certification tests, and STOL handling qualities in landing approach, in which both simulator and flight results were obtained. Comparison of these results provides further information on simulator requirements. In piloted ground research simulation, visual cues and task objectives are important in jet transport landings; only visual cues are required in many takeoff certification maneuvers, but are not sufficient for all maneuvers; and sophisticated motion simulation is important in STOL airplane landing approach studies. Author

N64-26582* Lockheed-Georgia Co., Marietta Advanced Studies Div.
A SURVEY OF HYPERSONIC SHOCK TUNNEL FACILITIES EMPLOYING HEATED DRIVER GASES
R. F. Sturgeon Mar. 1964 12 p ref
(Contract NAS8-11078)
(NASA-CR-56517; ER-6833) OTS: $1.60 ph

This report presents a compilation of the data received in response to questionnaires submitted to appropriate companies and agencies to determine the extent to which the several methods of driver gas heating are used in hypersonic shock tunnel facilities. A listing of the participants who contributed to the survey is included. Descriptions of facilities employing heated driver gases in hypersonic shock tunnels, which are grouped with respect to the heating method used, are given. Author

N64-26596* Massachusetts Inst. of Tech., Cambridge Man-Vehicle Control Lab.
THE DESIGN AND CONSTRUCTION OF AN ACCELERATION CART
Richard J. Schulte and Russell E. Vreeland (M.S. Thesis) Jun. 1964 93 p refs
(Grant NsG-577)
(NASA-CR-58128; T-64-1) OTS: $8.60 ph

This thesis presents a discussion of the problems encountered in designing and constructing a simulator to determine human vestibular response to a range of linear accelerations from 0 to 3g's. Starting with a set of initial performance specifications, the designers combined an array of commercially available components into a system, which, although requiring further refinements before completion, shows considerable promise of fulfilling the initial requirements. The resulting system consists of a wheeled vehicle, driven by a cable and drum arrangement, powered by a hydraulic pump and motor, and controlled by a hydraulic–electric servovalve. Technical design considerations are presented along with a discussion of the trade-offs between various component options. A description of the system characteristics as well as an analysis of preliminary test results and recommendations for future system improvements are included. Author

N64-26772 Rome U. (Italy) Centro Ricerche Aerospaziali
STRUCTURAL ANALYSIS OF THE SCOUT LAUNCHER ADAPTER FOR THE SANTA RITA PLATFORM. PART I: NATURAL ENVIRONMENT
Paolo Santini, Mario Marconi, and Claudio Covacci Apr. 1964 31 p refs

The Scout launcher adapter for the Santa Rita platform must be stiff enough to satisfy the vehicle and launcher requirements and must be strong enough not to exceed the prescribed stress limits of the material in both natural and induced environment. The stiffness and the strength of the adapter are the subjects of this analysis. The minimum dimensions of the Italian commercial tubes were determined, to afford the imposed structural loads with sufficient stiffness in natural environment. The stiffness and the stresses of the adapter were verified under the blast effect of the Altair motor. The diameter of the tubular bars of the chosen truss adapter able to afford the required stiffness was 244.5 mm, with a corresponding thickness of 6.3 mm. Author

N64-26792 Stanford U., Calif. Stanford Linear Accelerator Center
TWO-MILE ACCELERATOR PROJECT Quarterly Status Report, 1 Jan.–31 Mar. 1964
Jun. 1964 88p refs
(Contracts AT(04-3)-400; AT(04-3)-515)
(SLAC-30) OTS: $2.00

Discussions are presented that concern plant engineering, accelerator structures, Klystron studies, electronics, microwave engineering and injection, systems engineering and installation, Mark IV program, and preoperations research and development. R.T.K.

N64-26794 Rome U. (Italy) Centro Ricerche Aerospaziali
RANGE SAFETY PLAN—SOUNDING ROCKETS LAUNCH FROM EQUATORIAL RANGE
Aldo P. Berlese 8 Feb. 1964 12 p

Ground safety and flight safety of a tubular, zero-length launcher, mounted on a drilling-tower-type platform is reviewed. The launcher has two possible missions—to measure skin temperature, and the generation of a sodium cloud for measurements of upper-atmosphere characteristics. Data are presented for the following: (1) the vehicle—main motors and igniters, igniter squib characteristics, pyrotechnics and other hazardous installations, and vehicle radiofrequency transmitters; (2) prelaunch and launch danger areas; (3) range geometry; (4) flight parameters; (5) nominal launch angles; (6) the nominal trajectory; (7) the flight program; (8) nominal impact data; (9) wind measurements, weighting, and limitations; and (10) range clearance and surveillance. I.v.L.

11 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; 13 Heat Transfer and Thermodynamics; and 24 Physics, Plasma.

N64-25924 Republic Aviation Corp., Farmingdale, N.Y.
RESEARCH INVESTIGATION OF HYDRAULIC PULSATION CONCEPTS Fifth Quarterly Progress Report, 1 Mar.–31 May 1964
W. E. Mayhew 31 May 1964 25 p
(Contract AF 33(657)-10622)
(RAC-933-5; AD-600663)

The component design program was completed, and the analog computer program was started; the data from this program will be used to corroborate and supplement that taken on the miniaturized pulsating hydraulic system. Author

N64-25958 Technical Operations Research, Burlington, Mass.
STUDY OF BOMB DEBRIS EFFECTS. VOLUME I: THE TECH/OPS TWO-DIMENSIONAL TIME-DEPENDENT HYDRODYNAMICS CODE, APPLICATION TO SHOCK INTERACTION STUDY, 1962–1963 Final Report
Martin D. Torrey and Melvin R. Rubin 14 Feb. 1964 89 p refs
(Contract DA-19-020-ORD-5408)
(TO-3-64-10; AD-601585)

This report describes the two-dimensional, time-dependent hydrodynamics code modified to simulate the interaction between a reentry vehicle and the shock wave from a nuclear burst at intermediate altitude. The simulation method requires that the calculations be able first to describe axially symmetric steady flow about an obstacle. Modification of the code to provide steady-flow solutions on the IBM 7090/7094 computer and subsequent application to the shock interaction problem are described and demonstrated. A streamline program for displaying and using the results is included. Author

N64-25966 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
RECORDER OF PRESSURE PULSATIONS AND THEIR FREQUENCIES IN LIQUID AND GAS FLOWS
Samoylovich and I. Neruda 27 Apr. 1964 4 p Transl. into ENGLISH from Soviet Patent No. 154070, 11 Jun. 1962 p 1–2
(FTD-TT-64-181/1+2+4; AD-600779)

A recorder is described that has a simple design and permits direct recording of the average time magnitude of the pulsation of gas and liquid flow. This is achieved by placing hydrodynamic elements in both measuring lines of the recorder, thereby forming a parabolic horn. The lines have different discharge rates depending on the direction of the flow of the water. The elements are oriented differently relative to the measured flow. A schematic diagram of the recorder is included. R.T.K.

N64-26027 Philipps-Universitat, Marburg (W. Germany) Inst. fur Struktur der Materie
METHODS TO SOLVE THE EQUATIONS FOR FLUCTUATION PHENOMENA IN LOW DENSITY GAS Technical Final Report, 1 May 1963–29 Feb. 1964
Gunther Ludwig [1964] 78 p refs
(Contract DA-91-591-EUC-2918-01-360)
(AD-600763)

An iteration method and a singularity analysis method are presented for obtaining the solutions to equations previously developed for the purpose of describing fluctuation phenomena in gases. P.V.E.

N64-26031 France Ministere de l'Air, Paris
CONTRIBUTION TO THE STUDY OF [WATER] JETS. FORMATION AND DEFLECTION [CONTRIBUTION A L'ETUDE DES JETS. FORMATION ET DEVIATION]
Henri Reitzer Serv. de Doc. Sci. et Tech. de l'Armement, 1964 89 p refs in FRENCH *Its* Publ. Sci. et Tech. no. 403

The research discussed is a contribution to the experimental study of jet formation and deflection, with emphasis on the angles of deflection and on the effect of the constriction that accompanies jet deflection when the orifice is at a finite distance. A jet of water, having a square cross section, was chosen for two purposes: (1) to effect a cylindrical baffle plate, and thereby, to approximate the theoretical conditions of a two-dimensional flow; and (2) to compare the results obtained with those given by the theory of jets and wakes. This theory

is applied to the problem of deflection, and the flow was calculated according to Birkoff and Kadosch. The jet apparatus, its focusing, and the formation and structure of a jet produced by a nozzle having a square cross section are described. Also, the directional deflections caused by a single impediment are described. Two of these impediments are plane in nature, namely, a riser and a flap. The third impediment, representing profile, is a vane. Trans. by I.v.L.

N64-26066 David Taylor Model Basin, Washington, D.C. Structural Mechanics Lab.

AN EXPERIMENTAL INVESTIGATION OF CLOSURES AND PENETRATIONS FOR PRESSURE VESSELS OF COMPOSITE CONSTRUCTION

Thomas J. Kiernan and Martin A. Krenzke Feb. 1964 38 p refs

(Rept.-1732; AD-600336)

An experimental investigation is made of closures and penetrations for pressure vessels of composite construction designed for deep depths. A method is presented for designing reinforcement for penetrations through hemispherical closures to provide membrane boundaries. Test results indicate that no serious difficulty is involved in closing as well as penetrating cylindrical hulls of composite construction. Author

N64-26068 Canadian Armament Research and Development Establishment, Valcartier

THE GROWTH OF THE TURBULENT INNER WAKE BEHIND A 3 INCH DIAMETER SPHERE

R. Knystautas Jan. 1964 26 p refs

(ARPA Order-133)

(CARDE-TN-488/64)

The width of the turbulent inner wake behind 3-in.-diam solid aluminum spheres was measured for wake lengths extending up to 1,500 body diameters. The spheres were launched at an initial Mach 6 into atmospheric air by a conventional solid-propellant gun. The measured growth rate of the turbulent inner wake is in good agreement with the growth rate predicted in the analysis of Lees and Hromas. The agreement is good even to the extent of showing the region of the inflection point in the growth curve beyond which there is an increase in the growth rate. Although the 3-in.-diam spheres represent a size factor of up to 12 from the spheres launched at other laboratories, no obvious scaling effect is apparent in the growth rate of the turbulent inner wake, at this pressure and in this Mach number region, when results are compared. Author

N64-26128 Royal Aircraft Establishment, Farnborough (Gt. Brit.)

UNSTEADY SHOCK PROPAGATION IN A RELAXING GAS

D. A. Spence *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 43–47 ref (See N64-26126 18-01)

A study is made of the motion of the shock wave produced when a piston is impulsively set in motion with constant velocity into a diatomic gas at rest, conditions being such that behind the shock there is a zone of vibrational or dissociational relaxation. The dissociation case is treated by the method of linearized characteristics, using a form for the rate equation due to Freeman, while the vibrational case is included in a discussion in which the third-order equation for acoustic disturbances derived by Chu is applied to the flow behind the shock. In either case the initial speed of the shock is that corresponding to frozen flow between it and the piston, but the lower speed calculated from equilibrium thermodynamics is approached at large times. Distributions of pressure and velocity between the piston and the shock are found: at long times after the start of the motion these are precisely those given by the Bethe-Teller theory for partly dispersed shock waves. Some applications to other shock motions are discussed. Author

N64-26131 Aberdeen Proving Ground, Md. Ballistic Research Labs.

CHARACTERISTIC CALCULATION OF NON-EQUILIBRIUM FLOWS

R. Sedney, J. C. South, and N. Gerber *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 89–104 refs (See N64-26126 18-11)

The problem of computing nonequilibrium flows by the method of characteristics is studied. The frozen characteristics could be used, even arbitrarily close to equilibrium. However, the standard difference technique was not successful in such a computation. A more accurate technique was developed that was successful; this technique is of second-order accuracy. The choice of dependent variables was important to the success of the computation. The results of computing flows over wedges with vibrational relaxation are given. Far from the tip of the wedge the equilibrium state near the wedge is not uniform; the pressure is constant but the temperature is not. Thus an entropy layer exists at the wedge surface. Some approximate solutions for this flow are discussed. Author

N64-26136 Naples U. (Italy) Instituto di Aeronautica

ON TWO NEW METHODS FOR THE SOLUTION OF NON-EQUILIBRIUM FLOWS

Luigi G. Napolitano *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 191–216 refs (See N64-26126 18-11)

Two methods of solutions for nonequilibrium flow fields are presented. The first one is related to linear flow fields and entails a suitable series solution in terms of a parameter that is a measure of the difference between the equilibrium and frozen Mach numbers of the unperturbed stream. The second one is related to one-dimensional flow fields and is based on the construction of uniform approximations to the solutions of a system of ordinary differential equations containing a small parameter in the higher derivatives. Applications of the two methods to specific cases and appropriate comparison with available exact results have proved the following: (1) the simplicity of the methods of solutions; (2) the accuracy of the results; and (3) the potentialities of the methods both with respect to their applications to the classes of linear and one-dimensional flow fields and with respect to their possible extensions to more general flow fields. N.E.A.

N64-26141 United Aircraft Corp., East Hartford, Conn. Research Labs.

AN EXPERIMENTAL METHOD FOR MEASURING THE FLOW PROPERTIES OF AIR UNDER EQUILIBRIUM AND NON-EQUILIBRIUM FLOW CONDITIONS

Olof L. Anderson *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 299–313 refs (See N64-26126 18-01)

A spectroscopic method suitable for use in shock tubes and other high-temperature test facilities has been developed to measure the temperature and mole concentration of oxygen in air between 300° K and 3000° K with microsecond time resolution. This measuring technique is based on the light absorption properties of the oxygen molecule in the Schumann-Runge continuum that may be related to the vibrational temperature and mole concentration of oxygen in air. Since vibrational temperature and mole concentration may be defined without the assumption of thermodynamic equilibrium, this

method is particularly suitable for measurements of the properties of air that are not in chemical equilibrium. Temperature and density measurements of shock heated oxygen–argon mixtures and also air were made to evaluate the accuracy of the equipment. It was determined that measurements of temperature between 1,000° and 3,000° K can be made with 10% to 15% accuracy and that measurements of mole concentration can be made with about 4% accuracy. Author

N64-26142 France Office National d'Etudes et de Recherches Aeronautiques, Chatillion-sous-Bagneux
IMPROVEMENT OF A SHORT-ARC WIND TUNNEL BY THE ACCOMPLISHMENT OF A ROTATING ARC IN A HIGH COMPRESSION CHAMBER [AMELIORATION D'UNE SOUFFLERIE A ARC BREF PAR LA REALISATION D'UN ARC TOURNANT DANS LA CHAMBRE HAUTE PRESSION]
M. Delattre *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 315–322 in FRENCH (See N64-26126 18-01)

The O.N.E.R.A. has developed an arc wind tunnel, known as the ARC 1, whose flow-generating conditions are obtained by the dissipation of energy, in the neighborhood of 1 megajoules, inside a 1 cubic decimeter arc chamber. This report discusses the possible utilization of a rotating arc to reduce contamination in the wind tunnel and to produce a mixing within the chamber that would be favorable to the homogenization of the gas temperature. The principle of rotating the arc is based on the introduction of a magnetic field that is of a configuration suitable to the interior of the arc chamber. I.v.L.

N64-26153 Purdue U., Lafayette, Ind. School of Aeronautical and Engineering Sciences
FUNDAMENTAL EQUATIONS OF RADIATION GAS DYNAMICS
R. Goulard *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 529–554 refs (See N64-26126 18-01)

Radiation energy transfer is introduced as an average representation of electromagnetic transport processes. Fundamental properties are defined and an analogy drawn with molecular properties. The interaction parameters with homogeneous matter and with interfaces are discussed. Radiation terms are then introduced into the conservation laws and into several classical relations of fluid dynamics. Author

N64-26160 France Office National d'Etudes et de Recherches Aeronautiques, Chatillion-sous-Bagneux
DEVELOPMENT OF THE BOUNDARY LAYER IN A HYPERSONIC TUBE [DEVELOPPEMENT DE LA COUCHE LIMITE DANS UNE TUYERE HYPERSONIQUE]
R. Michel *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 693–716 refs in FRENCH (See N64-26126 18-01)

A review is presented of research conducted to establish the bases of an approximate calculation, for predicting the development of a boundary layer at nozzle walls for the case of a high-enthalpy hypersonic flow. A method of calculation is proposed that is a prolongation and an extension of the procedure established for a turbulent boundary layer, and is within the framework of two hypotheses— a perfect gas with constant specific heats; and the boundary-layer thickness, in front of the longitudinal radius of curvature of the wall, is negligible. I.v.L.

N64-26263 RAND Corp., Santa Monica, Calif.
AN ANALYSIS OF THE PARTICLE-IN-CELL NUMERICAL PROCESS IN ONE-DIMENSIONAL PROBLEMS
R. A. Papetti Apr. 1964 92 p refs
(Contract AF 49(638)-700)
(RM-3613-PR; AD-436542)

Preliminary results of a study made on the subject of a Particle-In-Cell (PIC) error analysis for lineal flows with slab symmetry are presented. The primary results of the study are divided into four main categories: (1) the establishment of the extent of an analytical error study; (2) the determination of a mathematical model of the PIC process and a statement of the necessity for such a model; (3) the determination of a set of difference equations that, within certain limits, are considered to be analogous to the PIC "method;" and (4) the determination of a set of differential equations whose solutions are (within certain limits) supposed to be reproduced by the PIC method. P.V.E.

N64-26288 California Inst. of Tech., Pasadena Karman Lab.
RADIANT ENERGY EMISSION FROM ISOTHERMAL AND NON-ISOTHERMAL GASES
M. Thomas and S. S. Penner *In its* Approximate Theoret. Calculations of Continuum Opacities, I. Radiant Energy Emission from Isothermal and Non-Isothermal Gases, II Nov. 1963 p 19–32 refs (See N64-26286 18-24)

Three topics in radiation gas dynamics are considered: (1) a specification of the relative importance of thermal conduction and radiation in heated air for the diffusion and transparent gas approximations; (2) an examination of the failure of the Eddington–Barbier approximation in radiative heat transfer for line radiation; and (3) some remarks on radiant energy transfer from nonisothermal air, particularly from heated air behind shock fronts. Author

N64-26309 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
LAMINAR BOUNDARY LAYER
L. G. Loytsyanskiy 7 May 1964 574 p refs Transl. into ENGLISH of the book "Laminarnyy Pogranichnyy Sloy" Moscov, Gos. Izd. Fiz.-Mat. Lit., 1962 p 1–479
(FTD-TT-63-749/1+2; HD-601756)

This book on the theory of laminar boundary layer is divided into 12 chapters. The first three chapters contain an outline of the theory of a plane stationary layer, including both exact and approximate methods of solution. These three chapters, together with the next four, present a generally complete theory of uniform isothermal boundary layers in an incompressible fluid. The general equations for a laminar boundary layer in a gas at high speeds and high temperatures are considered in chapter eight. Chapter nine examines the application of special cases for the equation considered in chapter eight to the exact and approximate solution of plane and three-dimensional problems relating to heat transfer and diffusion of impurities in an incompressible fluid, under condition of low-temperature differences and minor changes in impurity concentrations. Chapter ten discusses the theory of laminar, stationary, and nonstationary boundary layers on a plate in a gas stream moving at high speeds. Isobaric boundary layers relating to motions other than longitudinal flow past a plate are examined in chapter eleven. Chapter twelve contains a discussion of methods for the calculation of a boundary layer in the case of longitudinal changes in pressure in the external stream of a flow past a plate. P.V.E.

N64-26324 France Ministere de l'Air, Paris
A CONTRIBUTION TO THE STUDY OF TURBULENCE SPECTRA [CONTRIBUTION A L'ETUDE DES SPECTRES DE TURBULENCE]
Regis Dumas (Aix-Marceille U.) Serv. de Doc. Sci. et Tech. de l'Armement, Feb. 1964 121 p refs in FRENCH *Its* Publ. Sci. et Tech. no. 404

This report consists of three sections, the first of which deals with a review of the classical experimental method: the energy spectrum of turbulence, defined by G. I. Taylor, and formulated from a harmonic decomposition (in the practical case, a Fourier integral), was measured by a linear filter. The second section deals with the experimental results, obtained in a wind tunnel, for the turbulent velocity, particularly downstream of grids and rods and in the boundary layers of flat plates. The third section presents a calculation of the effect of filtering on the correlation value of two variables—time and the longitudinal interval (distance) of the longitudinal fluctuations in velocity. The contribution of different spectral bands to the correlation in time and interval of turbulent fluctuations was established for a particular case. I.v.L.

N64-26326 Advisory Group for Aeronautical Research and Development, Paris (France)

SUPERSONIC FLOW, CHEMICAL PROCESSES AND RADIATIVE TRANSFER

D. B. Olfe and V. Zakkay ed., Oxford, N.Y., Pergamon, 1964 484 p refs Pergamon $9

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18. THERMAL RADIATION OF A FLAME WITH CONDENSED MgO PARTICLES R. Rossler (Inst. Franco-Allemand de Recherches) p 433–438 refs (See N64-26340 18-26)

19. RADIATION COOLING OF AERODYNAMICALLY HEATED SURFACES AT HIGH MACH NUMBERS D. E. Rosner (AeroChem Research Labs.) p 439–483 refs (See N63-12805 06-02)

N64-26327 France Office National d'Etudes et de Recherches Aeronautiques, Chatillon-Sous-Bagneux

INFLUENCE OF CHEMICAL REACTIONS ON FLOW [INFLUENCE DES REACTIONS CHIMIQUES SUR L'ECOULEMENT]

Marcel Barrere *In* AGARD Supersonic Flow, Chem. Processes and Radiative Transfer 1964 p 31–77 refs In FRENCH (See N64-26326 18-11) Pergamon: $9

Different types of flows with variation in chemical composition are defined, and equations governing movement of fluids with variable chemical composition are recalled. Flows with equilibrium composition are calculated systematically with the help of partial derivative equations. Flows with nonequilibrium (evolving) composition are calculated; the method of calculating flows with chemical reactions is explained; and applications are described that include nozzle flow, supersonic combustion, and catalytic reactions along the nozzle.

Trans. by D.E.W.

N64-26328 General Applied Science Labs., Inc., Westbury, N.Y.

SUPERSONIC DIFFUSION FLAMES

Joseph A. Schetz *In* AGARD Supersonic Flow, Chem. Processes and Radiative Transfer 1964 p 79–91 refs (See N64-26326 18-11) Pergamon: $9

The diffusion and combustion of hydrogen in air at supersonic speeds are treated analytically by considering the limiting cases of reaction controlled and diffusion controlled processes. Two dimensional turbulent jet mixing with equilibrium chemical behavior is treated in detail as the diffusion controlled case.

Author

N64-26331 Royal Aircraft Establishment, Farnborough (Gt. Brit.)

SOME EFFECTS OF STABLE COMBUSTION IN WAKES FORMED IN A SUPERSONIC STREAM

L.H. Townend and J. Reid *In* AGARD Supersonic Flow, Chem. Processes and Radiative Transfer 1964 p 137–155 refs (See N64-26326 18-11) Pergamon: 9 £

In a wind-tunnel flow of Mach 2.14 hydrogen gas was bled into the wake flows formed by a strut-mounted cone cylinder of 1-in. diameter with a blunt base and with conical afterbodies of semi-angles 30° and 22 1/2°. Combustion of hydrogen in the form of diffusion flames was stabilized in these wakes, and a consequent reduction in base drag was demonstrated, the increased base pressure in some cases slightly exceeding the local upstream static pressure on the cylindrical surface. Measurements were also obtained for peripheral and axial injection of hydrogen (without combustion) and of nitrogen into the wake of the blunt base. Some data were correlated by evaluation of an appropriately defined specific fuel consumption. Author

N64-26333 General Dynamics/Astronautics, San Diego, Calif. Space Science Lab.

TRANSONIC ASPECTS OF HYPERVELOCITY ROCKET PLUMES

J. Bowyer, L. D'Attorre and H. Yoshihara *In* AGARD Supersonic Flow, Chem. Processes and Radiative Transfer 1964 p 201–209 ref (See N64-26326 18-11) Pergamon: 9 £

Two cases involving a hypervelocity jet are described in which transonic flow regions arise. The first involves a rocket exhaust expanding into a vacuum and then interacting with an infinite ground plane. The second concerns the expansion of a rocket into a low pressure, high Mach number uniform flow. A procedure is given to compute this flow. To illustrate the procedure to calculate the transonic region arising within the jet plume, an example where a Mach disk configuration arises due to flow non-uniformities at the nozzle exit has been computed. The theoretical results of the two cases are compared with experiments, and good agreement was obtained. Author

N64-26334 Northern Research and Engineering Corp., Cambridge, Mass.

THE CALCULATION OF HEAT AND MASS TRANSFER THROUGH THE TURBULENT BOUNDARY LAYER ON A FLAT PLATE AT HIGH MACH NUMBERS, WITH AND WITHOUT CHEMICAL REACTION

D. B. Spaulding, D. M. Auslander, and T. R. Sundaram *In* AGARD Supersonic Flow, Chem. Processes and Radiative Transfer 1964 p 211–276 refs (See N64-26326 18-11) Pergamon: 9 £

Tables and graphs are provided that permit the swift calculation of drag, heat transfer, and coolant rate for a flat plate with a turbulent boundary layer, in a stream of air at high Mach number, when transpiration-cooled by air, helium, or hydrogen. The Mach-number range covered by the tables is 0 to 12, and the ratio of wall temperature to stream temperature ranges from 0.05 to 20.0. Two sets of tables are provided for hydrogen, one for the case in which combustion occurs and another for that in which it does not. The tables are based partly on theoretical derivations and partly on experimental results. Surveys are included in the paper both of earlier theories and of most available experimental data. Although the latter afford some guidance as to which sets of assumptions are to be preferred, some unresolved questions remain. The need for more data is emphasized. Author

N64-26337 Brown U., Providence, R.I.

ON PHOTOIONIZATION AHEAD OF A STRONG SHOCK WAVE

Carlo Ferrari and Joseph H. Clarke *In* AGARD Supersonic Flow, Chem. Processes and Radiative Transfer 1964 p 375–398 refs (See N64-26326 18-11) Pergamon: 9 £

(Contract Now-62-0604-C)

Explicit gasdynamic equations for unsteady, rectilinear motion are deduced from the statistical mechanics for an ionizing and radiating gas, when both of these processes are out of equilibrium. An estimate is then given of the degree of ionization produced upstream of a strong normal shock wave by radiation from the hot nonequilibrium region downstream of the shock. Results of the theory and estimate are compared with experiments and interpreted in terms of relevant mean free paths. Author

N64-26338 Manchester U., Macclesfield (G. Brit.)

RADIATIVE IONIZATION FRONTS IN HYDROGEN

F. A. Goldsworthy *In* AGARD Supersonic Flow, Chem. Process and Radiative Transfer 1964 p 399–411 refs (See N64-26326 18-11) Pergamon: 9 £

The gas dynamical effects of radiation that lead to the establishment of ionized gaseous regions are investigated. The region in which transition from atomic to the ionized state occurs is assumed to be thin, and for the flow in the large the transition region can be replaced by a discontinuity, which is termed a radiative ionization front. The properties of such ionization fronts are discussed, and the analogy with combustion waves is noted. An analysis of the structures of ionization fronts is given, together with a few computed examples of weak R-type ionization fronts (corresponding to weak detonation waves), which might have possible application to the discussion of precursor radiation. The effect of frequency dependence of the absorption coefficient is included in the analysis so that the spectral quality of the radiation at any point might be examined. Author

N64-26468* Pennsylvania State U., University Park Ordnance Research Lab.

THE INVESTIGATION OF TENSIONS IN LIQUIDS Progress Report

J. William Holl and Richard E. Bland Jun. 1964 15 p refs (GRANT NSG-85-60)

An apparatus for applying a rapidly changing pressure to a column of liquid is described. The apparatus is designed to apply the load as a single impulse without subjecting the liquid to any previous loads of the chosen magnitude. Basically, the apparatus consists of a piston located at the bottom of a liquid column contained within a glass tube. The piston is moved downward by the action of a falling weight, and the result is an expansion wave that produces tension. The apparatus is to be used in studying cavitation formation in a liquid under tension. P.V.E.

N64-26480 Marquardt Corp., Van Nuys, Calif.

ANALYSIS OF DROPLET EVAPORATION AND COMBUSTION IN HYPERSONIC STREAMS

Eugene B. Zwick and Donald H. Grubman [1963] 23 p refs

Equations describing droplet diameter, temperature, and position as functions of time are derived, and approximate analytical solutions are obtained. Exact numerical solutions for some particular cases are obtained using a digital computer, and the effect of the initial conditions is examined. The analytical solutions are compared with the exact numerical solutions and show reasonable agreement. Curves showing the theoretical distance required for combustion are presented for both the burning and nonburning (evaporation only) cases and are compared. The distance required for combustion and/or evaporation is a strong function of initial droplet size. The combustion rate is initially at a maximum and decreases rapidly with distance from the injector. Author

N64-26498 RAND Corp., Santa Monica, Calif.
AN APPLICATION OF SINGULAR INTEGRAL-EQUATION THEORY TO A LINEARIZED PROBLEM IN COUETTE FLOW
A. Leonard and T. W. Mullikin May 1964 27 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4027-PR; AD-600832)

This paper treats a linearized problem in Couette flow derived from a simple version of the Krook statistical model for intermolecular collisions. The problem is reduced to the solving of Fredholm equations that converge rapidly for all values of the Knudsen number. The methods are based on singular integral equations and were first developed in neutron and radiative transport theory. Cercignani, in applying Case's method to the slip flow problem, also studied singular equations dual to those of this paper. Author

N64-26523 Iowa State U. of Science and Tech., Ames Ames Lab.
RADIAL VARIATION OF EDDY DIFFUSIVITY TENSOR COMPONENTS FOR THREE-DIMENSIONAL MASS TRANSPORT
Alvin Eugene Konopik and Ray Fahien Feb. 1964 127 p refs
(Contract W-7405-ENG-82)
(IS-830) OTS: $2.50

Eddy diffusivities and 90% confidence limits for mass transport as a function of radial position and Reynolds number were determined for turbulent flow of water in a pipe. The experimental data were obtained in a 4-in. copper pipe with two salt injection tubes placed diametrically at the wall of the pipe. The salt concentrations as functions of angular and radial position were obtained by an electrical conductivity method and were time-averaged using an analog computer. An IBM-7074 digital computer was used in the calculation of the diffusivities from the concentration profiles. Author

N64-26572 France Ministere de l'Air, Paris
THEORETICAL AND EXPERIMENTAL RESEARCH ON NONLINEAR OSCILLATIONS OF HEAVY LIQUIDS IN BASINS AND CHANNELS OF CONSTANT DEPTH [RECHERCHES THEORIQUES ET EXPERIMENTALES SUR LES OSCILLATIONS NON LINEAIRES DES LIQUIDES PESANTS DANS LES BASSINS ET CANAUX DE PROFONDEUR CONSTANTE]
Pierre Gaillard Serv. de Doc. Sci. et Tech. de l'Armement. Dec. 1963 177 p refs in FRENCH *Its* Publ. Sci. et Tech. no. 402

This report is divided into three sections. The first deals with a theoretical study of multiperiodic, three-dimensional gravity waves of weak amplitude in a channel of arbitrary length. In addition to irrotational waves and those that do not permit liquid transport, a class of motions, which has a strictly longitudinal distribution of entrainment velocity, is examined. Poincare's method of small parameters is employed to explain, to an approximate second order relative to cambers, particle displacement, particle velocity, pressure, and vortex field. The second section deals with a theoretical study of seiches generated in a rectangular tank and seiches that are produced in a channel by a surge generator. A second-order solution for nonreasonant motions, according to Takano, is presented. The third section deals with an experimental study of the propagation of subharmonics excited by the presence of an interfering, binodal, transverse plash. The rapidity of propagation of the harmonic periods 2 T/3 and 2 T/5 verify, to approximately 1%, the classical formula of Airy. I.v.L

N64-26630* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
AN INITIAL VALUE METHOD FOR THE NUMERICAL TREATMENT OF THE ORR-SOMMERFIELD EQUATION FOR THE CASE OF PLANE POISEUILLE FLOW
Philip R. Nachtsheim Washington, NASA, Aug. 1964 30 p refs
(NASA-TN-D-2414) OTS: $0.75

An exact numerical method is presented for the calculation of the eigenvalues in the problem of the stability of plane Poiseuille flow. The method appears to be rapid and highly accurate and can easily be generalized to solve more complex stability problems. The method of solution consists of treating the boundary value problem as an initial value problem. The results obtained agree closely with the numerical results of Thomas. Author

N64-26637 Pratt and Whitney Aircraft, East Hartford, Conn.
TABLES OF COMPRESSIBLE FLOW FUNCTIONS
1963 265 p refs

These tables contain the Mach number functions most frequently used in the analysis of steady or nonsteady, inviscid, compressible flow. The Mach number range includes values from M = 0 to M = 20; the ratio of specific heats (gamma) varies from 1.10 to 1.667; ideal thrust and nonsteady flow functions are presented; and special flow functions extremely useful for solving the heat-addition problem in a constant area duct and the mixing of parallel streams in a constant area duct are also included. Functions are presented for different specific heat ratios as functions of Mach number. All functions were computed on an IBM 7090 computer and are given to 5 significant figures. R.T.K.

N64-26644 Massachusetts Inst. of Tech., Cambridge Gas Turbine Lab.
THE BEHAVIOR OF TURBULENT BOUNDARY LAYERS IN ADVERSE PRESSURE GRADIENTS
Hal L. Moses Jan. 1964 87 p refs
(Contract Nonr-1841(91))
(Rept.-73; AD-438000)

The problem of predicting the behavior of the incompressible turbulent boundary layer in an adverse pressure gradient is reexamined. An outline of the problem is given along with a brief summary of the work already done, including both experimental correlations and approximate theories. The results of an experimental investigation are presented for a separating turbulent boundary layer with various pressure distributions. An approximate theory is developed in which the momentum integral equation is satisfied for each half of the boundary layer. The velocity profiles used in the analysis consist of the well-known wall and wake regions, resulting in a two-parameter family with the Reynolds number as one parameter. It is assumed, with some experimental justification, that the eddy viscosity can be reasonably approximated from zero pressure gradient experiments. The numerical calculations, using the Runge–Kutta procedure, show good agreement with the experiments. The reliability that can be expected of such approximate methods is discussed. Author

N64-26708 Allied Research Associates, Inc., Concord, Mass.
NUMERICAL METHODS FOR COMPUTING THE DENSITY OF A RAREFIED GAS ABOUT A MOVING OBJECT Final Report
Lee W. Parker Mar. 1964 156 p refs
(Contract AF 19(628)-2782)
(ARA-F-9221-4; AFCRL-64-193; AD-600401)

Two basic computer programs are presented for the computation of particle densities throughout the interior of a spatial volume in an arbitrary potential field. They are aimed at the general problem of computing the density distribution about an object moving through a gas sufficiently rarefied that corrections for collisions are small or negligible. Two approaches were designed for the collision-free potential problem, in which the potential is defined on a discrete mesh of spatial points, for numerical purposes. In one of the approaches, the densities are also defined on a mesh of points, and the whole space is correspondingly divided into discrete small volumes associated with the mesh points. The computation follows a large number of particles injected at an outer boundary surface and sums density contributions within the discrete volumes along the trajectories in proportion to the times spent in the volumes. The other approach evaluates the integral of the local Boltzmann distribution function directly, by computing a triple sum of trajectories whose behavior is governed by the potential field. Runs made with this program in an arbitrary potential field defined by a mesh of points also yielded physically expected density distributions. The problem of collisional corrections in the case of a disc moving through a rarefied neutral gas is formulated. Methods for evaluating the collision integrals are discussed, based on the model of elastic spheres. Author

N64-26729 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
HEAT POWER ENGINEERING Selected Articles
25 Mar. 1964 22 p refs Transl. into ENGLISH from Teploenerg. (Moscow), no. 6, 1963 p 46–48, 58–61
(FTD-MT-63-202; AD-295443)

CONTENTS:

1. ON THE EFFECT OF IRREGULARITY OF FLOW ON CHARACTERISTICS OF LATTICES A. V. Gubarev and Li Tsai-Hsiu p 1–8 refs

2. DISTRIBUTION OF TEMPERATURE IN THE ZONE OF THE ROOT JOINT OF A COOLED BLADE OF A GAS TURBINE Ye. I. Molchanov and Ye. R. Plotkin p 9–18 refs

N64-26751* Consultants and Designers, Inc., Arlington, Va.
GROUP CLASSIFICATION OF EQUATIONS DESCRIBING THE ONE DIMENSIONAL NONSTATIONARY GAS FLOWS [GRUPPOVAYA KLASSIFIKATSIYA URAVNENIY OPISYVA-YUSHCHIKH ODNOMERNYYE NESTATSIONARNYYE TECHENIYA GAZA]
K. P. Surovikhin 8 Jul. 1964 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR: Gidromekhanika (Moscow), v. 156, no. 3, 21 May 1964 p 533–536
(Contract NAS5-2078)
(NASA-TT-F-8921; ST-AD-10167)

One-dimensional flows with an arbitrary dependence on the cross section of the surface of the tube through which the current flows are examined. A system of equations describing the one-dimensional nonstationary flows in the hydraulic approximation is given. R.T.K.

N64-26771 Argonne National Lab., Ill. Chemical Engineering Div.
FREE CONVECTION OF A LOW PRANDTL NUMBER FLUID IN CONTACT WITH A UNIFORMLY HEATED VERTICAL PLATE
K. S. Chang, R. G. Akins, L. Burris, Jr., and S. G. Bankoff Jan. 1964 80 p refs
(Contract W-31-109-ENG-38)
(ANL-6835) OTS: $2.00

A first-order perturbation analysis was made of laminar free convection of an incompressible viscous fluid from a uniformly heated vertical plate with both leading and trailing edges. The zeroth-order solution is the exact boundary-layer solution in terms of the similarity variable, η, given by Sparrow and Gregg. New zeroth-order results are presented for Prandtl numbers (Pr) of 0.03 and 0.01, showing that the heating effect is still appreciable even at $\eta=20$. Sparrow's and Gregg's solution for $Pr=0.1$ was repeated to obtain the required accuracy for the first-order perturbation. The correction due to the first-order perturbation was then made by matching a boundary limit problem for the boundary layer to an interior limit problem for the external inviscid flow. The first-order vertical velocity was obtained from a sink-strength distribution at the plate for the potential flow that, in turn, was based on the horizontal velocity component at the edge of the boundary layer. Extensive numerical results are presented. R.T.K.

N64-26776* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
MOBILITY OF POSITIVE IONS IN THEIR OWN GAS: DETERMINATION OF AVERAGE MOMENTUM-TRANSFER CROSS SECTION
John W. Sheldon Washington, NASA, Aug. 1964 22 p refs
(NASA-TN-D-2408) OTS: $0.50

The energy-dependent charge exchange cross section is integrated over the appropriate energy distribution to yield the average momentum cross section for an ion in its own gas. This momentum cross section $\bar{Q}$ is presented in terms of charge exchange constants A and B, numerical constants $\xi = 0.577\ldots$ and $K = 2.492\ldots$, the atomic polarizability α, and the thermal energy of the gas kT. The average momentum cross section obtained from the resulting equation can be used to compare energy-dependent charge exchange cross section data with mobility data; this is illustrated by an example for several inert gas ions in their own gas. The average momentum cross section was also used to compute the mobility of alkali–metal ions in their own vapor. The calculations reveal errors in earlier numerical approaches. Author

N64-26777* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
ANALYSIS OF EFFECT OF COMPENSATING-BELLOWS DEVICE IN A PROPELLANT LINE AS A MEANS OF SUPPRESSING ROCKET PUMP INLET PERTURBATION
William Lewis and Robert J. Blade Washington, NASA, Aug. 1964 13 p refs
(NASA-TN-D-2409) OTS: $0.50

An analysis of pressure and flow perturbations produced in a propellant feed system by fundamental-mode longitudinal oscillations of the structure of the vehicle is used to derive an expression for transfer function that relates the pump-flow perturbation to unit structural oscillation velocity for a system in which a compensating-bellows device is located between the feed line and the pump inlet. The device consists essentially

of an enclosed variable volume that is controlled by the relative motion of two parts of the structure that oscillate with different amplitudes. Results of the analysis indicate that pump-inlet flow perturbations can be suppressed by a suitable selection of the compensating-bellows parameters. Author

N64-26829 Army Missile Command, Huntsville, Ala.
ON THE PRESSURE LOSS IN VENT PIPES WITH BUILT-IN INSTALLATIONS
E. Hübner 13 Jul. 1964 50 p refs Transl. into ENGLISH from Forsch. Gebiete Ingenieurw., (Germany), v. 19, no. 1, 1953 p 1–16
(RSIC-211; AD-443432)

Losses caused by the installation, inside ducts, of grids composed of rods with sharp edges, were calculated from the nonuniform potential flow and the theory of momentum. It was possible to determine the losses in the inlet flow as well as in the produced turbulent flow from pressure measurements and flow patterns on various models of build-in installations. This made possible also the determination of the interaction of a series of grids. The results are applicable to already constructed shafts. The practical installation of a series of rod grids in a given shaft depth is described; the gain in ventilating efficiency when employing profile dividers is estimated, and the more or less complete lining of the side seams of the shaft, to reduce the ventilating resistance, is discussed. Author

N64-26838* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
EXPERIMENTAL SLOSHING CHARACTERISTICS AND A MECHANICAL ANALOGY OF LIQUID SLOSHING IN A SCALE-MODEL CENTAUR LIQUID OXYGEN TANK
Irving E. Summer, Andrew J. Stofan, and Daniel J. Shramo Washington, NASA, Aug. 1964 28 p refs
(NASA-TM-X-999) OTS: $0.75

An experimental investigation of liquid sloshing in a 1/3.75 scale-model Centaur stage liquid oxygen tank was conducted to determine the fundamental frequencies of oscillation, the horizontal slosh forces and damping ratios (logarithmic decrements) occurring at the fundamental frequencies, and the slosh damping effectiveness of a proposed slosh baffle. Experimental data were obtained for clean, unbaffled, and baffled tank configurations. The measurement of vertical and horizontal slosh forces enabled the determination of quantities for a pendulum analogy that would effectively describe liquid sloshing in the unbaffled tank configuration. Several quantities determined for such an analogy included the length of the pendulum arm, the maximum angles through which the pendulum can oscillate, the hinge point location of the pendulum, the pendulum or sloshing mass, the fixed or nonsloshing mass, and the geometric centroid location of the fixed mass. The results of this investigation are presented in terms of dimensionless parameters that are applicable to tanks of any size having similar configurations. Author

N64-26839* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
EFFECT OF INITIAL VELOCITY ON ONE-DIMENSIONAL, AMBIPOLAR, SPACE-CHARGE CURRENTS
Walton L. Howes Washington, NASA, Aug. 1964 21 p refs
(NASA-TN-D-2425) OTS: $0.50

Oppositely directed flows of positive and negative charges constitute an ambipolar current. A general case is analyzed in which the charges traverse the evacuated space between plane-parallel boundaries, and all particles of a given charge species are monoenergetic. It is assumed that the charges may possess nonvanishing initial kinetic energy. This represents an extension of analyses by Langmuir and Müller–Lübeck for vanishing initial kinetic energy. Sample calculations of dimensionless current densities, electric and potential fields, and charge-density distributions are exhibited for cases where the electric field is assumed to vanish at one boundary but the species initial velocities may not. Resulting ion currents may be several times the Child's law limit if initial kinetic energies are of the order of the potential energy. Author

N64-26849 Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Research Labs.
STUDY AND EXPERIMENTAL WORK ON ATOMIC COLLISION PROCESSES OCCURRING IN ATMOSPHERIC GASES
A. V. Phelps 30 Jun. 1964 5 p refs
(Contract AF 29(601)-6271)
(RM-64-928-113-M5; AD-603532)

Most of the effort in electron-positive ion recombination was devoted to the analysis of the effects of a nonuniform spatial distribution of electrons and positive ions on the relation between the apparent and actual recombination coefficients determined from measurements of electron-loss in the afterglow of a microwave discharge. Measurements of electron drift velocities in $Xe–O_2$ and $Xe–N_2$ mixtures were made to obtain experimental data that allow more accurate determinations of the inelastic scattering cross section in O_2. Previous measurements, which yielded widths of the peaks of the electron currents in pure H_2O corresponding to D/μ values for the electrons, in agreement with recent results of Crompton, were extended to a wider range of pressures. Considerable effort was devoted to the improvement of the procedure for determining the O–concentration, in attachment and detachment studies in $O–O_2$ mixtures, using NO_2 titration. The microwave discharge produces approximately 4% atomic oxygen. I.v.L

N64-26858 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE SOLUTION OF BOUNDARY LAYER EQUATIONS BY THE DIFFERENCE METHOD
I. Yu. Brailovskaya and L. A. Chudov 16 May 1963 19 p refs Transl. into ENGLISH from the Book: "Vychislitel'nyye Metody i Programmirovaniye; Izdatel'stvo Moskovskogo Universiteta, I", 1962 p 167–182
(FTD-TT-63-285/1+2+4; AD-409560)

This article presents the methods and results of the numerical solution of the system of equations of a two-dimensional steady-state boundary layer on a plate. The examined method can be applied in the particular case of a homogeneous incompressible fluid and in the general case of a multicomponent compressible gas taking into account heat transfer and diffusion. Author

N64-26932 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THERMAL BARRIER WITH TURBULENT BOUNDARY LAYER OF GAS
S. S. Kutateladze and A. I. Leont'yev 11 May 1964 19 p refs Transl. into ENGLISH from Teplofiz. Vysokikh Temperatur (USSR), v. 1, no. 2, 1963 p 281–290
(FTD-TT-64-332/1+2+4; AD-602314)

An approximate method is given for calculating the thermal regime of a solid surface past which flows a turbulent, homogeneous, quasi-isothermal boundary layer with various methods of setting the thermal barrier. Author

N64-26940 Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
ELECTROMAGNETIC INDUCTION ON AN EXPANDING CONDUCTING SPHERE Technical Report
Luiz C. Bahiana (Ph.D. Thesis—1962) 30 May 1964 75 p refs
(Contract DA-36-039-AMC-03200(E))
(TR-421; AD-602435)

One of the explanations that has been proposed for the origin of the radio signals emitted by nuclear explosions in the atmosphere is that such signals are generated by the interaction of the hot, expanding, electrically conducting gases, which result from the explosion, with the earth's magnetic field. The model adopted for the study of this process consists of a conducting sphere expanding radially in a uniform, static magnetic field. The velocity is prescribed, as a function of space and time, for all points in the interior of the sphere. The problem consists in the determination of the electromagnetic fields and the electromagnetic force acting on the sphere as a result of its expansion. By prescribing the velocity, the hydrodynamic problem, which is difficult to solve, is avoided, and the problem is restricted to the domain of classical electromagnetic theory. The major part of the work reported here is concerned with the case of a perfectly conducting expanding sphere. This problem is solved rigorously with the help of an integral equation relating the current density to the magnetic vector potential. The fields are determined in integral form for any arbitrary velocity of expansion, and calculated explicitly for the particular case of constant velocity of expansion. The physical interpretation of these solutions is discussed. The electromagnetic force acting on the sphere is found, and the energy–power balance at the surface of the sphere is investigated with the help of Poynting's theorem. Author

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Includes auroral phenomena; upper atmosphere studies; oceanography; cartography; geodesy; and geomagnetism. *For Van Allen belts see*: 28 Space Radiation. *For related information see*: 05 Astronomy and Astrophysics; 21 Meteorology; and 29 Space Sciences.

N64-26001* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GEOMAGNETIC CONTROL OF THE ELECTRON DENSITY IN THE *F* REGION OF THE IONOSPHERE
R. A. Goldberg, P. C. Kendall, (Sheffield U.) and E. R. Schmerling (NASA, Washington, D.C.) Repr. from J. Geophys. Res., v. 69, no. 3, 1 Feb. 1964 p 417–427 refs
(Grants AF-EOAR-61-41; NSF-G-22040)
(NASA-RP-263)

The solution of a problem recently treated by Goldberg and Schmerling is written in a simple closed form. The problem concerns a possible explanation of the geomagnetic anomaly in terms of diffusion along the magnetic lines of force for a special model of the F_2-layer at the magnetic equator. At great height the results obtained are roughly in agreement with observations made by the Alouette (S-27) satellite. The theoretical electron density at fixed height is given as a function of magnetic latitude for a wide range of expected conditions at various phases of the solar cycle. Curves showing the latitude variation of $[\delta(\log N)\delta r]^{-1}$ at great height are also given. The results are discussed. IAA

N64-26022 American Meteorological Society, Boston, Mass.
METEOROLOGICAL AND GEOASTROPHYSICAL ABSTRACTS, VOLUME 14, NUMBER 12, DECEMBER 1963.
M. Rigby, ed. Dec. 1963 269 p refs
(Sponsored by NASA, NSF, DOD, WB, VODC)

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1. ANNOTATED BIBLIOGRAPHY ON LUNAR INFLUENCES ON ATMOSPHERIC AND GEOPHYSICAL PHENOMENA. PART II W. Nupen and G. Thuronyi, eds. p 3958–4019 refs (See N64-26023 18-12)

N64-26023 American Meteorological Society, Boston, Mass.
ANNOTATED BIBLIOGRAPHY ON LUNAR INFLUENCES ON ATMOSPHERIC AND GEOPHYSICAL PHENOMENA. PART II
Wilhelm Nupen and Geza Thuronyi, *In its* Meteorol. and Geoastrophys. Abstracts, v. 14, no. 12, Dec. 1963 p 3958–4019 (See N64-26022 18-12)

This bibliography comprises over 300 abstracts of the most important literature relating to lunar influences on atmospheric, ionospheric, geomagnetic, and cosmic ray phenomena. Literature on lunar influences on gravity, or on oceanic and earth tides on the one hand, and on weather phenomena on the other hand has, as a rule, been omitted. A selection of papers of historical interest, dating back as far as Laplace (1825), who was the first to work out a theory of atmospheric tidal motion and to determine its magnitude, has been included. I.v.L.

N64-26042 Canadian Armament Research and Development Establishment, Valcartier Electronics Wing
AN OUTLINE OF SOME CHARACTERISTICS OF THE UPPER ATMOSPHERE
W. J. Surtees Mar. 1964 130 p refs
(CARDE-TR-470-64)

This report described, mainly in graphical form, some of the principal characteristics and the composition of the upper atmosphere to an altitude of 700 k. Temporal and geographic variations and extremes are emphasized. Experimental and theoretical determinations are indicated, and estimates of experimental accuracies are given. Author

N64-26076* National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md.
TELEVISION CINEMAPHOTOGRAPHY OF AURORAS AND PRELIMINARY MEASUREMENTS OF AURORAL VELOCITIES
T. N. Davis and G. T. Hicks (Naval Res. Lab.) Repr. from J. Geophys. Res., v. 69, no. 9, May 1, 1964 p 1931–1932 ref
(NASA-RP-255)

This is a description of a series of tests performed on the usefulness of an image orthicon closed-circuit television system for indirect auroral photography. The system was equipped with an f/0.75 lens providing an effective field of view of 16°. Recording was accomplished by photographing the television monitor with a 16-mm cinema camera. Operated at maximum sensitivity, the system allowed direct viewing of 8th- and 9th- magnitude stars on the television monitor. At this sensitivity level, the system was somewhat better than the unaided, dark-adapted human eye in the detection of weak auroral structures. No difficulty was found in obtaining auroral photographs of even the weakest structures with exposures of 1/60 sec at the normal sound cinema rate of 24 frames

18-12 GEOPHYSICS

per second. For brighter forms it was necessary to electronically reduce the system sensitivity. Examples of some of the photographs are presented. IAA

N64-26182 Kiruna Geophysical Observatory (Sweden)
AURORAL ZONE IONOSPHERIC RESEARCH ANNUAL
Lubwik Liska and Alv Egelano 20 Mar. 1964 35p refs
(Contract AF 61(052)-678)
(AFCRL-64-353; AD-602655)

The analysis of 20 months' observations made at Kiruna Geophysical Observatory (ϕ = 67°. 8 N, λ = 20° E) was carried out with emphasis on Faraday rotation and scintillation phenomenon. The direction of the horizontal component of the geomagnetic field in the F-region differs by about 8° from that at ground level. Increases of the rate of Faraday rotation observed in the auroral zone were explained in terms of large horizontal variations of the total electron content. The amplitude of these variations is about one order of magnitude larger than those observed at middle latitudes. Also temporal and spatial distributions of the scintillation activity were investigated. Naturally occurring electromagnetic radiation in the audiofrequency range was also studied. The results obtained are to some extent compared with similar measurements at Sagamore Hill, Mass., carried out during the same period. Several emission bands, which are quite distinct from the normal background-signals and are obtained as strong enhancements in portions of the spectrum, were recorded. Author

N64-26206 Aberdeen Proving Ground, Md. Ballistic Research Labs.
HANDBOOK FOR PREDICTION OF AIR BLAST FOCUSING
Beauregard Perkins, Jr. and Willis J. Jackson Feb. 1964 93 p refs
(BRL-1240; AD-602112)

This handbook sets forth the procedures and techniques for gathering and evaluating the meteorological data necessary for predicting the focus of air blast from surface or near surface explosions, and describes simple devices to speed the calculations. All the graphs necessary for the evaluation are gathered for easy reference. Eighty-seven sets of vertical velocity gradients and the resulting sound ray paths are assembled for rapid determination of focal distance. These cover most of the conditions to be expected throughout the continental United States. Author

N64-26220 Alaska U., College Geophysical Inst.
AN INVESTIGATION OF SOLAR INDUCED PHENOMENA AT MAGNETICALLY CONJUGATE POINTS Final Report, Part I
Eugene M. Wescott and Keith B. Mather May 1964 168 p refs
(Contract AF 19(628)-2779)
(UAG-R146; AFCRL-64-274; AD-602296)

The results of a study of solar-induced geophysical phenomena at pairs of stations linked by a magnetic-field line have established that magnetic variations (except S_q), telluric currents, ionospheric absorption, visual auroras, very-low-frequency and extra-low-frequency emissions, and auroral X-rays occur in similar manners in conjugate areas—similar in time, form, and amplitude. D.E.W.

N64-26295* Alaska U., College Geophysical Inst.
THE DEVELOPMENT OF GEOMAGNETIC STORMS AFTER A NEGATIVE SUDDEN IMPULSE
Syun-ichi Akasofu Repr. from Planet. Space Sci., v. 12, 1964 p 573–578 refs
(Grant NsG-201-62)

The solar plasma flow by itself may be a ncesssary condition for the development of geomagnetic storms, but not a sufficient condition. Additional factors are needed for the ring current and auroral activity. Examples are given to show that appreciable geomagnetic storms sometimes do not develop until after an abrupt reduction of the plasma pressure to the level prevailing before the *SSC*-value. Results obtained by Mariner II are also discussed. Author

N64-26297* Southwest Center For Advanced Studies, Dallas, Tex.
DIURNAL VARIATION OF THE HYDROGEN CONCENTRATION IN THE EXOSPHERE
W. B. Hanson and T. N. L. Patterson Repr. from Planet. Space Sci., v. 11, 1963 p 1035–1052 refs Previously Published as NASA-CR-50409; See N63-18177 16-12
(Grant NsG-269-62)

Three effects that must contribute to the diurnal variation of the abundance of atomic hydrogen in the exosphere of the earth are enhanced escape of hydrogen from the sunlit exosphere associated with the higher daytime temperatures, lateral flow of hydrogen around the earth resulting from a departure of the hydrogen abundance from spherical symmetry, and flow of hydrogen into and out of the protonosphere by charge exchange oxygen ions. Estimates are made of the importance of these effects. It is concluded that lateral flow of hydrogen is very efficient in preventing the formation of a large day–night asymmetry in the abundance of hydrogen. Author

N64-26375* New Hampshire U., Durham
EVIDENCE OF HYDROMAGNETIC WAVES IN THE EARTH'S MAGNETOSPHERE AND OF THEIR PROPAGATION TO THE EARTH'S SURFACE
V. L. Patel and L. J. Cahill, Jr. [1963] 10 p refs
(Contract NASw-155)
(NASA-CR-58130) OTS: $1.10 ph

The first evidence of elliptically polarized hydromagnetic waves in the ground records of the earth's magnetic field at College, Alaska, was communicated by Sugiura (1961). This note presents more conclusive evidence of such waves in the magnetosphere, using the total vector magnetic-field measurement by the Explorer XII magnetometer and simultaneous ground magnetic records from College, Alaska. The waves were found to be elliptically polarized with a period of approximately 120 to 180 sec. The transverse hydromagnetic waves seen on the ground at College originated close to the geomagnetic field boundary that was 55,000 km on September 4, 1961. I.v.L

N64-26422* Consultants and Designers, Inc., Arlington, Va.
SPECTRAL COMPOSITION OF THE VARIABLE EMISSION COMPONENT IN THE CONTINUOUS SPECTRUM OF THE NIGHT SKY [O SPEKTRAL'NOM SOSTAVE PEREMENNOY SOSTAVLYAYUSHCHEY IZLUCHENIYA V NEPRERYVNOM SPEKTRE NOCHNOGO NEBA]
V. M. Morozov 29 Jun. 1964 9 p refs Transl. into ENGLISH from Astron. Zh. (USSR), v. 41, no. 2, 1964 p 378–381
(Contract NAS5-2078)
(NASA-TT-F-8918; ST-AA-10164)

Various data on the night sky emission in the continuous spectrum are briefly summarized. The results of photoelectric observations of the night sky emission near λλ 4280, 5280, 5710, 5890, and 6300 A, made in Zevnigorod during August 1957 to October 1959, are analyzed. The intensity distribution in the night sky continuous spectrum is very similar to that of the G2-type stars. Data on large variations of the spectral composition of the continuum are not corroborated, and the possible variations lie within small limits. Author

N64-26464 Bureau of Mines, Denver, Colo. Denver Mining Research Center

SIMULATING MINERAL DEPOSITS USING MONTE CARLO TECHNIQUES AND MATHEMATICAL MODELS

Richard F. Hewlett 1964 32 p refs

(BM-RI-6493)

This report presents the computer programing methods and mathematics required to generate either random numbers or normal random numbers to be used for the construction of statistical probability models for simulating mineral deposits by Monte Carlo techniques. Theoretical frequency functions are evaluated as an illustration of simulation applications. Numerical and analytical methods of simulating and dissecting some complex frequency distributions are described. Author

N64-26481 International Council of Scientific Unions, Paris (France) International Association of Geomagnetism and Aeronomy

GEOMAGNETIC DATA 1960. INDICES K AND C

J. Bartels, A. Romana, and J. Veldkamp 1963 109 p refs (IAGA-BULL.-1201) Available from North-Holland Publ. Co., Amsterdam: $2.00

The following information is included in these indices: (1) a graphic representation of the observatories which furnished K-figures for the years 1947 to 1960; (2) the eight K-indices for each day of 1960 for the magnetic observatories that were active during the entire year; (3) the C-figures for 104 observatories for each day of the year 1960; (4) the international geomagnetic character-figures Ci, 1960, obtained by averaging the value of the C-figures for each day; (5) a summary of the selected quiet and disturbed days for 1960; (6) the mean international character–figure Ci by months and by years, for the years 1900 to 1960, (7) a summary of the K-indices for 1960 that contains the usual Kp-table, supplemented by equivalent ranges for expressing the magnetic activity in some linear scale, in addition to the quasi-logarithmic scales of the K and Kp indices; (8) the frequencies of K_p-indices for each month of 1960; (9) the averages of A_p and C_p for the months and the year 1960; (10) a list of magnetic storms during 1960; (11) a list of very quiet intervals during 1960 Kp not exceeding 1+ for at least 8 intervals (= one day) in succession; and (12) a table of references for all lists concerning K_p, A_p, and C_p for previous years—the polar year 1932/33 and 1932 to 1960. I.v.L.

N64-26496 Royal Aircraft Establishment, Farnborough (Gt. Brit.)

VALUES OF UPPER-ATMOSPHERE SCALE HEIGHT FROM THE ORBITS OF VOSTOKS 3 AND 4

D. G. King-Hele Mar. 1964 5 p refs

(RAE-TM-SPACE-31)

The density scale height H of the upper atmosphere is found from the orbits of Vostok III and IV. The values obtained are $H = 31 \pm 2$ and 34 ± 2 km, respectively, at a height of 200 km. Author

N64-26592* Smithsonian Astrophysical Observatory, Cambridge, Mass.

ATMOSPHERIC DENSITIES AND TEMPERATURES FROM THE DRAG ANALYSIS OF THE EXPLORER 17 SATELLITE

Jack Slowey 1 Jul. 1964 17 p refs

(Grant NsG-87-60)

(NASA-CR-58032; SAO Special Rept.-157) OTS: $1.60 ph

Atmospheric densities were obtained from the drag analysis of the Explorer XVII satellite. Temperatures from the densities were computed, using a modified version of Nicolet's atmospheric model. The analysis was based on field-reduced Baker–Nunn observations and on Minitrack observations. The density in Nicolet's model corresponding to a given exospheric temperature is, relative to the densities higher up, too large at low heights. The same result was found in an earlier analysis of the Injun III satellite. Irregular fluctuations in density, with a range corresponding to 30 to 40° F in temperature, occur during geomagnetically quiet intervals. These fluctuations are correlated with small variations in the average K_p geomagnetic index. The heating that accompanies smaller magnetic storms may be considerable greater than previous results have indicated. The increase in temperature may very well be proportional to K_p, rather than to A_p, for K_p equal to 6 or more. Author

N64-26606 Joint Publications Research Service, Washington, D.C.

ON THE GEOCENTRIC LATITUDE OF A SPACE POINT

A. A. Izotov 7 Aug. 1964 7 p Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 6, 1964 p 3–5

(JPRS-25771; TT-64-41042) OTS: $1.00

A formula is derived for the geocentric latitude with an arbitrary position of the space point relative to the surface of the terrestrial ellipsoid. The difference between the geodetic and geocentric latitudes of a point on an ellipsoid can be tabulated by the argument of either latitude. Then, in order to determine the geocentric latitude of a space point, it is sufficient to compute the difference between the following geocentric latitudes: the point in question A and its projection A_0 on the surface of the ellipsoid. For this purpose, the following exact formula for this difference is obtained from the triangle A_0OA: $\sin(\phi - \phi_0) = H \sin(B - \phi_0/r + \Delta$, where H is the altitude, B the geodesic latitude, and $r + \Delta$ is a segment of the triangle. I.v.L.

N64-26608* Consultants and Designers, Inc., Arlington, Va.

SPECTROPOLARIMETRY OF THE TWILIGHT SKY AT THE ZENITH [SPEKTROPOLYARIMETRIYA SUMEROCHNOGO NEBA V ZENITE]

L. N. Bondarenko 8 Jul. 1964 7 p refs Transl. into ENGLISH from Astron. Zh. (USSR), v. 41, no. 2, 1964 p 383–386

(Contract NAS5-2078)

(NASA-TT-F-8922; ST-AA-SP-10169)

As the sun sets below the horizon, light is scattered by higher and higher atmosphere layers. Observation data on sky light polarization at the zenith were obtained at different moments of twilight, in the morning and evening. The polarization differs considerably from the theoretical Rayleigh values and the difference increases with solar depression. The dependence between polarization and wavelength at different moments of twilight is found. The polarization variations are compared with intensity variations at different solar depressions. Author

N64-26613 Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.

WHISTLER DETERMINATION OF ELECTRON ENERGY AND DENSITY DISTRIBUTIONS IN THE MAGNETOSPHERE

H. B. Liemohn and F. L. Scarf (Space Technol. Labs.) Mar. 1963 74 p

(DI-82-0245)

Fifty-seven nose whistlers recorded at 5 stations were employed to test the validity of model magnetospheric electron distributions and two theories for the upper cutoff frequency of the whistler signal. Five electron density distributions [constant, $\exp(3R_e/R)$, $(R_e/R)^{+3}$, $(R_e/R)^{+3} \exp(3R_e/R)$, and $(R_e/R(0°))^{+3} \exp(°3R_e/R(0°) + 3R_e/R)$] were tested but only the ones with an $(R_e/R)^{+3}$ factor produce self-consistent

results. In the cases, the ratios of f_U, the upper cutoff frequency, to $f_c(0°)$, the equatorial gyrofrequency, are scattered with most whistlers having $f_U/f_c(0°) > 0.5$. This indicates that the cutoff is probably not caused by escape of high-frequency components from field-aligned ducts. On the other hand, the assumption that the cutoff above f_U is caused by a thermal doppler shift in the cyclotron resonance is strongly supported. For these whistlers the resonant particle energies at f_U range between 0.2 and 2.0 Kev and in this interval the differential energy spectrum of the normalized density, $N_o^{-1}dN(E)/dE$, is a remarkably smooth function that varies as E^{-1} with no significant height ($3 < R(0°)/R_e < 5$) or time variation.

Author

N64-26673 Eastman Kodak Co., Rochester, N.Y. Apparatus and Optical Div.

MEASUREMENT OF 15-MICRON HORIZON RADIANCE FROM A SATELLITE

J. Collinge and W. Haynie 1 Mar. 1963 56 p refs
(Contract AF 04(695)-160)
(EK-ARD-ED-995; Z-3112; AD-437804)

An orbital test program was conducted providing radiometric measurement of the sky-CO_2 horizon profile. The horizon profile was measured by detectors responding to radiation from spectral bandwidths of about 1.0, 2.0, and 3.0 μ centered near 15 μ. Profiles were recorded for all latitudes between 65° N and 65° S, including both day and night passes, for a period of about two days. The experimental results were compared with prior computations of the horizon profile based on the latest atmospheric model. The radiant emittance of the earth's atmosphere, as measured in the CO_2 absorption region from an orbiting satellite, agrees with predicted levels. The variations in the radiant emittance for all conditions encountered during the experiment are small. The horizon profile is not appreciably affected by vehicle altitude, latitude, or sun illumination. No appreciable brightening or darkening at the earth's limb is apparent. Author

N64-26712* Consultants and Designers, Inc., Arlington, Va.

THE INCREASE OF THE IONIZATION GRADIENT IN THE NEARBY MAGNETOSPHERE DURING PERIODS OF STRONG MAGNETIC ACTIVITY [AUGMENTATION DU GRADIENT D'IONISATION DANS LA PROCHE MAGNETOSPHERE EN PERIODES DE FORTE ACTIVITE MAGNETIQUE]

Yvonne Corcuff and Michel Delaroche 17 Jul. 1964 7 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. Ionosphere (Paris), v. 258, no. 2, 11 Jan. 1964 p 650–653
(Contract NAS5-2078)
(NASA-TT-F-8926; ST-AI-10173)

Analysis of some multiple whistlers, recorded at Poitiers (geomagnetic coordinates: 49.5° N to 81.8° E), during the recovery phase of magnetic storms, allows the derivation of the existence of strong ionization gradients at geocentric distances less than three earth's radii. Author

N64-26806* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

LATEST WIND ESTIMATES FROM 80 KM TO 200 KM ALTITUDE REGION AT MID-LATITUDES

W. T. Roberts 16 Jun. 1964 42 p refs
(NASA TM-X-53064) OTS: $4.60 ph

The data from a total of 40 rocket launches fired specifically to determine wind characteristics by the release of chemiluminescent trails were compiled and studied in an attempt to clarify seasonal and diurnal trends in upper atmospheric winds above 80 km. From a series of graphs taken at 10-km intervals, a general picture of the change in wind vectors with height is determined. Below 120 km there appears to be extreme variation in speed and direction with very little correlation with season or time of day discernible. Above 120 km, however, the winds appear to orient more with season, and above 150 km, some diurnal variations become apparent. Author

N64-26909 Kiruna Geophysical Observatory (Sweden)

A STUDY OF AURORAL ZONE IONOSPHERIC IRREGULARITIES MADE SIMULTANEOUSLY AT TROMSO, NORWAY AND KIRUNA, SWEDEN Scientific Report No. 6

Jon Frihagen and Ludwik Liszka (Norwegian Defence Res. Estab.) 20 May 1964 19 p refs
(Contract AF 61(052)-678)
(AFCRL-64-568; AD-603092)

The present paper gives the results of observations of satellite scintillation at 54 mc/s made simultaneously at Tromso, Norway (70° N, 19° E), and Kiruna, Sweden (68° N, 20° E), using sets of spaced receivers. In most cases, the height and the thickness of the layer producing scintillation were the same at both stations. A type of fast and very regular fading observed at both stations is discussed. Author

N64-26910 Kiruna Geophysical Observatory (Sweden)

SPECTROPHOTOMETRIC STUDIES OF AURORA Final Report

Georg Gustafsson 5 Jun. 1964 16 p refs
(Contract AF 61(052)-288)
(AFCRL-64-571; AD-603094)

The spectrophotometric measurements made at Kiruna Geophysical Observatory are summarized. The luminosity variations of a small area of the sky were studied; variations occur at frequencies above 1,000 cps. A new technique was developed for the study of auroral motions up to several tens of kilometers per second. Auroral motions were also studied on film. Luminosity curves of several auroral features were made at a high sweeping speed. The connection between magnetic variations, cosmic noise absorption, and the auroral luminosity was studied. Absorption events during the breakup phase of the aurora are very closely related to the luminosity variations. The correlation with magnetic variations was not equally good; in general the magnetic variations follow the luminosity variations better than the cosmic noise absorption when averaged over long time periods. Author

N64-26911 Kiruna Geophysical Observatory (Sweden)

MORPHOLOGY OF THE VISIBLE AURORA, ITS RELATION TO MAGNETIC VARIATIONS AND COSMIC NOISE ABSORPTION Scientific Report No. 4

Georg Gustafsson 21 May 1964 57 p refs
(Contract AF 61(052)-288)
(AFCRL-64-570; AD-603093)

An investigation was made of the morphology of the visible aurora at Kiruna. The study is based on all sky camera films and photometer recordings. The relation between visible aurora and other upper atmospheric parameters is also discussed. It was found that the maximum auroral activity occurred in 1960 2 years after the sunspot maximum. The latitude and time variations of the location of the auroral zone were studied, and it was found that the north–south motion of the zone during the night amounts to 1.5° of latitude of the average. The width of the half-intensity zone is 7°. Author

N64-26924 Uppsala U. (Sweden)

RELATIONS BETWEEN LIGHTNING DISCHARGES AND DIFFERENT TYPES OF MUSICAL ATMOSPHERICS

Harald Norinder [1963] 29 p refs Presented at the 3d Intern. Conf. on Atmospheric and Space Elec., Montreux, Switzerland, 6–10 May 1963 Sponsored by Intern. Union Geodeosy and Geophysics
(Contracts AF 61(052)-07; AF 61(052)-171)
(AFCRL-64-488; AD-603089)

Recording cathode-ray oscillographs were used for the analysis of the lightning discharges whose relations to musical atmospherics were investigated. Cathode-ray oscillographic direction finders placed at two stations with suitable distances between them made it possible to determine the sources of the lightning discharges investigated. Through comparative harmonic analyses, it was shown that lightning discharges producing musical atmospherics of the usual type—whistlers—were characterized by a preponderance of frequencies around 5 to 8 kc. Multiple lightning discharges were found to be followed by multiple whistlers. The recording method of the station allowed also an investigation of correlations between lightning discharges and musical atmospherics of unusual and irregular variational forms. N.E.A.

13 HEAT TRANSFER AND THERMODYNAMICS

Includes ablation; cooling; heating; and other thermal effects. *For aerothermodynamics see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 03 Aerodynamics of Wings, Rotors, and Control Surfaces. *For combustion see*: 26 Propellants and Combustion. *For related information see*: 11 Fluid Mechanics.

N64-25904* General Electric Co., Cincinnati, Ohio Missile and Space Div.
ALKALI METALS BOILING AND CONDENSING INVESTIGATIONS, VOLUME I Quarterly Progress Report No. 6, Oct. 1–Dec. 31, 1963
J. Longo, Jr., ed. 20 Apr. 1964 126 p refs
(Contract NAS3-2528)
(NASA-CR-54037) OTS: $10.10 ph

Heat-transfer data obtained in the 300-kw facility, using the nominal 1.0-in., Mo-0.5Ti boiler tube with the helical insert, are reported. These data include 98 boiling runs and 10 liquid-liquid runs and encompass the following range of variables: potassium subcooling, °F—254 to 501; potassium flow rate, lbs/sec—0.106 to 2.191; potassium exit quality, %—0 to 60; sodium flow rate, lbs/sec—1.321 to 12.027; sodium inlet temperature, °F—1,196 to 1,850; and heat transferred, Btu/sec—31.060 to 77.712. In addition to the reduced data, several calculated quantities for each run, such as the overall heat-transfer coefficient, exit quality, vapor velocity, and inlet subcooling, are presented. I.v.L.

N64-25905* General Electric Co., Cincinnati, Ohio Missile and Space Div.
ALKALI METALS BOILING AND CONDENSING INVESTIGATIONS Quarterly Progress Report No. 7, Jan. 1–Mar. 31, 1964
Frank E. Tippets, ed. 20 Apr. 1964 265 p refs
(Contract NAS3-2528)
(NASA-CR-54038) OTS: $17.00 ph

This program is being conducted for NASA in order to obtain two-phase heat-transfer and fluid-flow data for sodium and potassium under conditions of boiling and condensing. The current work includes the design and development of a multitube, once-through boiler. Work is summarized in the following areas: (1) the 300-, 100-, and 50-kw loop projects; (2) pool boiling investigation; and (3) activities concerning facilities, materials development, and instrumentation. R.T.K.

N64-25910* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER AND PRESSURES ON A SWEPT CYLINDER IN THE VICINITY OF ITS INTERSECTION WITH A WEDGE AND FLAT PLATE AT MACH NUMBER 4.15 AND HIGH REYNOLDS NUMBERS
Ivan E. Beckwith Washington, NASA, Jul. 1964 22 p refs
(NASA-TN-D-2020) OTS: $0.50

Heat-transfer rates and pressures were measured on a circular cylinder in the region of flow interference caused by an adjoining 8° half-angle sharp wedge. Data were obtained at sweep angles of 20° and 60° with respect to the free-stream flow direction. At the 20° sweep angle some data were obtained with a flat plate as well as with the wedge. The test Reynolds numbers were sufficiently large so that the boundary layer was always turbulent on the cylinder and wedge or plate. For 20°-sweep angle the peak values of pressure and heat transfer occurred about half a cylinder diameter from the wedge and were apparently caused by local flow conditions and separation on the wedge upstream of the cylinder. When the sweep angle was 60°, no separation occurred, and the peak pressure and heat transfer on the cylinder could be accurately predicted by the theory for turbulent heating on a yawed cylinder from the local flow conditions on the wedge. The local effect on the heating rates of the shock-wave impingement from the wedge was negligible at both sweep angles. Author

N64-25971* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CALORIMETRIC HEATING-RATE PROBE FOR MAXIMUM-RESPONSE-TIME INTERVAL
Robert H. Kirchhoff Repr. from AIAA Journal, May 1964 p 966–967 refs
(NASA-RP-238)

Presented is the development of equations that can be employed in the design of a calorimetric probe having the longest possible linear temperature–time response for a given material, an allowable front-face temperature rise, and fixed heating rate. For the development of the equations, the probe is considered to be a finite slab of material with a uniform heating rate at the front face, and insulated on the sides and back face, thus reducing the problem to one of one-dimensional heat conduction. IAA

N64-25983 RAND Corp., Santa Monica, Calif.
DECELERATION AND MASS CHANGE OF AN ABLATING BODY DURING HIGH-VELOCITY MOTION IN THE ATMOSPHERE
Carl Gazley, Jr. Apr. 1964 38 p refs Presented at the 2nd All-Union Conf. on Heat and Mass Transfer, Minsk, 4–9 May 1964
(P-2900; AD-600692)

The factors affecting the dynamics and mass loss of ablating bodies during high-velocity motion are examined. The classic meteor case, where the flow is assumed to be of the free-molecule type with constant heat-transfer and drag coefficients, is reviewed and presented in terms of

general dimensionless parameters, which allow application to cases other than that of meteor atmospheric entry. In general, cases with variable heat-transfer and drag coefficients require numerical machine solutions. However, analytic solutions for certain cases are possible and are presented. R.T.K.

N64-26014 American Society of Heating, Refrigerating and Air-Conditioning Engineers, New York, N.Y.
THE ROLE CRYOGENICS IS PLAYING IN EXPANDING MECHANICAL ENGINEERING
V. J. Johnson, ed. [1963] 88 p refs Papers Presented at Am. Soc. of Heating, Refrig. and Air-Conditioning Engr. Cryog. Symp., New York, 11–14 Feb. 1963 NBS, Boulder, Colo: $2.00

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N64-26015 National Bureau of Standards, Boulder, Colo. Cryogenic Engineering Lab.
THE QUEST FOR DESIGN DATA
Richard B. Stewart *In* Am. Soc. of Heating, Refrig. and Air-Conditioning Engr. The Role Cryog. is Playing in Expanding Mech. Eng. [1963] p 15–24 refs (See N64-26014 18-13) NBS, Boulder, Colo.: $2.00

The acquisition of data for the design and analysis of cryogenic systems is representative of the quest that confronts the engineering profession in new fields of technology. The compilation of thermodynamic properties for the cryogenic fluids is used as an illustration of the problems of acquiring data. Authoritative tabulations of thermodynamic data are required, based on experimental data that were subjected to critical evaluation in selecting the best values of the data. Compilation groups, using the data available in the scientific literature, can generally lead the determination of new experimental data by years. The demands of new developments in cryogenics still outpace these efforts, however, and the design engineer often must perform data compilations within the scope of his immediate needs. Some examples of compilation problems are given that demonstrate techniques of data compilation, and include the extension of the oxygen property charts into the liquid range, the generation of P-ρ-T data for neon from corresponding states theory, and the determination of an equation of state for helium. Author

N64-26016 National Bureau of Standards, Boulder, Colo. Cryogenic Engineering Lab.
MODERN METHODS OF ANALYSIS FOR DESIGN OF CRYOGENIC EQUIPMENT AND PROCESSES
T. R. Strobridge and D. B. Mann *In* Am. Soc. of Heating, Refrig. and Air-Conditioning Engr. The Role Cryog. is Playing in Expanding Mech. Eng. [1963] p 25–38 refs (See N64-26014 18-13) NBS, Boulder, Colo.: $2.00

Interest in cryogenic processes and equipment has developed rapidly over the past few years. Exotic rocket fuels and oxidizers, cryogenic magnets, masers and infrared detectors are but a few of the applications of low temperature technology. With this increased interest it is necessary to design and develop systems of high efficiency and dependability. Accurate real gas thermodynamic property data for use in low temperature process optimization and analysis and experimental data reduction are essential to the study of these problems. High-speed digital computers were used to investigate refrigeration and liquefaction equipment and processes. Complex real gas-state equations are developed to describe broad regions of the pressure–density–temperature surface. The reduction of these state equations to thermodynamic property tables is made practical only with computers. These tabulated data for such refrigerants as helium, normal and para-hydrogen, neon, and nitrogen are used as input data for the computer. Performance of refrigeration and liquefaction systems incorporating unique or experimental components was investigated on paper by the computer before fabrication, thus saving time and reducing costs. After fabrication, test data are reduced, analyzed, and compared to these predictions. Author

N64-26017 Linde Co., Tonawanda, N.Y. Cryogenic Development Lab.
LIQUID NITROGEN: AN ALL PURPOSE EXPENDABLE REFRIGERANT
Frank Notaro *In* Am. Soc. of Heating, Refrig. and Air-Conditioning Engr. The Role Cryog. is Playing in Expanding Mech. Eng. [1963] p 39–52 refs (See N64-26014 18-13) NBS, Boulder, Colo.: $2.00

Liquid nitrogen is making its way as the most promising element of "canned" refrigeration. Along with its promise of refrigeration economy, it offers performance characteristics unmatched by standard methods of refrigeration—specifically, it offers effective and efficient distribution of refrigeration over a wide range of refrigeration requirements, extremely high reliability, and quiet operation. The typical liquid nitrogen system consisting of a suitable nitrogen supply, a nitrogen distributor, and a simple temperature controller finds wide application where total yearly refrigeration requirements do not economically justify high investments for equipment, where flexibility is required to accommodate large peak demands, or where effective control of temperature is required for ranges from less than −100° F to ambient conditions. Liquid nitrogen in transit refrigeration initially proposed for use with vehicles engaged in the local delivery of food, where recovery of cargo space temperature following deliveries poses a most severe performance requirement, is presently being extended in its application to intermediate and long haul operations for both frozen and perishable foods. The effectiveness and economy of liquid nitrogen refrigeration depend primarily on fleet operating practices, thermal characteristics of cargo, and thermal characteristics of the vehicle. Author

N64-26018 Little (Arthur D.), Inc., Cambridge, Mass. Cryogenics and Fluid Mechanics Group
CRYOGENIC EQUIPMENT DEVELOPMENT FOR SPACE
Arthur A. Fowle *In* Am. Soc. of Heating, Refrig. and Air-Conditioning Engr. The Role Cryog. is Playing in Expanding Mech. Eng. [1963] p 53–66 (See N64-26014 18-13) NBS, Boulder, Colo.: $2.00

The role of low-temperature technology in present and future space programs is reviewed. Some proven or promising applications, as the use of liquefier gases as propellants; the simulation of the low-temperature and high-vacuum characteristics of outer space in environmental test facilities; and the sub-zero refrigeration of electronic components, such as infrared detectors, inertial guidance devices, optical masers, etc., are discussed briefly. The function and nature of the cryogenic systems involved, their current development status, and future development needs are presented. The need for compact, efficient, and reliable low-temperature refrigerators and thermal protection systems is emphasized. Various technical approaches to the solution of problems in these critical areas are outlined, and, finally, some major challenges yet facing the engineer developing the cryogenic equipment needed for space ventures are set forth. Author

N64-26019* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
HEAT-TRANSFER AND FLOW DATA WITH CRYOGENIC HYDROGEN FOR NUCLEAR ROCKET SYSTEM DESIGN
David M. Straight *In* Am. Soc. of Heating, Refrig. and Air-Conditioning Engr. The Role Cryog. Is Playing in Expanding Mech. Eng. [1963] p 67–84 refs (See N64-26014 18-13) NBS, Boulder, Colo.: $2.00

The results of some recent experimental studies on heat transfer and pressure drop for two-phase and gaseous hydrogen flow at temperatures from 36° to 500° R and pressures from 1 to 3 atm are presented. A description and diagrams of the apparatus and a brief summary of some current tests are included. The data are presented in the form of the usual heat-transfer parameters, Nusselt, Reynolds, and Prandtl numbers, and also include a Martinelli parameter and a boiling number for two-phase flow conditions. Pressure drop data are presented as a comparison with calculated values from standard pressure drop equations. Author

N64-26060 Pratt and Whitney Aircraft, Middletown, Conn.
EXPERIMENTAL RESULTS OF FORCED CONVECTION BOILING POTASSIUM HEAT TRANSFER AND PRESSURE DROP TESTS **Air Research and Development Report**
16 Jul. 1964 81 p refs
(Contract AT(30-1)-2789)
(PWAC-429)

Experimental forced-convection boiling potassium heat transfer and pressure drop data were obtained at 1,725° F in a horizontal zero gravity boiler tube. System stability tests were conducted and the results compared with an electric analog of the system. A distinct condensing interface was observed in the condenser. Author

N64-26064 Polytechnic Inst. of Brooklyn, N.Y.
ABLATION OF A SOLID SPHERE OF A LOW CONDUCTIVITY MATERIAL
Richard F. Parisse Apr. 1964 31 p refs
(Contract Nonr-839(23))
(PIBAL-683; AD-600173)

An approximate solution is presented for determining transient temperature distributions and ablation rates for solid spheres of low thermal conductivity and constant thermal properties, subjected to point symmetric aerodynamic heat inputs. A short time solution for the temperature that is valid prior to ablation is developed by using Laplace transforms. The ablation solution is derived by approximation of the radial temperature profile by an exponential function and use of the heat balance technique. This results in a second-order, nonlinear, ordinary differential equation for the position of the ablating surface. Results of the numerical integration of the approximate solutions are compared with experimental data obtained at the stagnation point of a Plexiglas hemisphere tested under hypersonic flow conditions. A discussion of the techniques employed, as well as the comparison with experimental data, appears in the body of this report. Author

N64-26080* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TEMPERATURE DISTRIBUTION ON CONDUCTING CYLINDRICAL SHELLS INCLUDING THE EFFECTS OF THERMAL RADIATION
Max A. Heaslet and Franklyn B. Fuller Repr. from J. Soc. Indust. Appl. Math., v. 12, no. 1, Mar. 1964 20 p refs
(NASA-RP-264)

The dependence of heat transfer upon parametric values of structural emissivity, absorptivity, and thermal conductivity is demonstrated analytically. This paper is concerned with a thin, conducting cylindrical shell, either closed or open, but of sufficient length that a two-dimensional idealization is possible and heat transfer is calculated in a cross section. An external source of radiation is assumed. The thermal conductivity of the shell is known, and the radiative emission from the inner and outer surfaces is taken to be diffuse; also, no dependence on radiation wavelength is employed, and a gray-body-type analysis is used. R.T.K.

N64-26097 Canadian Armament Research and Development Establishment, Valcartier
THEORETICAL CALCULATIONS OF SURFACE TEMPERATURE AT THE NOSE OF A PROJECTILE **Interim Report**
D. Heckman Feb. 1964 30 p refs
(ARPA Order 133)
(CARDE-TR-481/64)

The analysis undertaken to perform a theoretical calculation of surface temperature at the nose of a projectile is described. Provision was made for estimates of the effects of preheating of the projectile during passage down the gun barrel. Two representations of the stagnation heating rate were derived based on different estimates of the thermodynamic variables behind the shock in front of a projectile traveling between 4,000 and 5,000 fps. The results of digital computer calculations of nose surface temperatures are presented, for varying degrees of barrel preheating. The results indicate that it will be difficult to isolate experimentally the contribution to the surface temperature of preheating in the gun barrel unless reception of telemetered temperature measurements begins as soon as the projectile exits from the gun muzzle. The maximum surface temperatures achieved are scarcely affected by preheating. Author

N64-26116 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
STUDY OF HEAT EMISSION DURING THE CONDENSATION OF MOVING STEAM IN A HORIZONTAL PIPE
L. D. Berman and Yu. A. Tumanov 5 May 1964 18 p refs Transl. into ENGLISH from Teploenerg. (Moscow), v. 9, no. 10, 1962 p 77–83
(FTD-TT-64-301/1+2; AD-602374)

The condensation of moving steam along a single pipe, which is located in a cluster of pipes, was investigated. Results are these: (1) A considerable increase in the coefficient of heat emission was noted with an increase in the speed of the steam over the entire investigated range of Reynolds number values (from 46 to 964). (2) The experimental curves $q = f(Re_n)$, where q

is the heat-emission coefficient of the moving stream and q_n is the heat-emission coefficient of the stationary steam, lay considerably higher than the curves computed according to the theoretical data of Nusselt. (3) Another substantial deviation of the experimental data from the computed ones was the very much greater (and reverse in sign) effect of the temperature head on the heat-emission coefficients. (4) Experimental deviation from computed values may be connected with the change in the flow system of the condensate film under the action of an outside disturbance brought about by the steam flow. I.v.L.

N64-26127* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HYPERSONIC AERODYNAMIC PROBLEMS OF THE FUTURE
H. Julian Allen *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 1–41 refs (See N64-26126 18-01)

Blunt shapes were of interest for the speed regime of ballistic missiles and satellite vehicles, in the main, as a result of the necessity for minimizing convective heating. As speeds exceed escape speed, the heating due to air radiation assumes an even more important role than does the convective heating. This change revives interest in the more slender configurations and when the speed of a vehicle entering the atmosphere of a planet becomes sufficiently great, it may be economical to decelerate in part by retrorocket rather than entirely by aerodynamic braking. The factors discussed determine the speed limit for which retrorocket braking becomes desirable. The change in the basic characteristics of flow brought about by gas radiation at speeds well in excess of escape speed is then analyzed. When the gas radiation energy becomes a significant part of the total energy of the flow, it is no longer possible to analyze aerodynamic flow fields with the assumption that the energy of elemental volumes remains constant, since for such cases a transfer of energy by radiation from one elemental volume to another significantly alters the flow. The increase in complexity in the analytical approaches to the problems of these hypersonic flows necessitates, more than ever, continued experimental research, even though such experiments are exceedingly difficult to perform. Extension of experimental knowledge of these hypersonic flows is possible by study of tracked trajectories of bright meteors. Some analyses of meteor tracking data are presented that demonstrate that the tracking camera systems employed at present can provide sufficiently accurate results to yield useful aerodynamic heating information Author

N64-26138 National Physical Lab., Teddington (Gt. Brit.) Aerodynamics Div.
TEMPERATURE MEASUREMENTS IN A HYPERSONIC SHOCK TUNNEL
K. C. Lapworth *In* AGARD The High Temp. Aspects of Hypersonic Flows 1964 p 255–269 refs (See N64-26126 18-01)

Temperatures in the region just before the reflecting end of a reflected-shock hypersonic tunnel were measured by the method of sodium-line reversal. Steady temperatures are achieved at below-tailoring conditions. Temperature measurements give a good indication of the actual duration of high temperature in the shock-heated gas. In many cases the duration of high temperature turns out to be much less than previously estimated. Author

N64-26139 National Physical Lab., Teddington (Gt. Brit.) Aerodynamics Div.
A MASS FLOW PROBE FOR USE IN SHORT DURATION HYPERSONIC FLOWS
R. J. Stalker *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 271–280 ref (See N64-26126 18-01)

A probe is described that measures mass flow per unit area in a hypersonic shock tunnel and therefore, in combination with the pitot pressure, provides a measurement of local velocity and density. Gas is entrained from a stream tube of known cross-sectional area, cooled to ambient temperature by passage through a bed of small glass spheres, and ejected through a choked orifice of known size. A measurement of pressure ahead of the orifice is then used to deduce the mass flow without reference to the high-temperature properties of the gas. Characteristics of the probe and experimental results are discussed. Author

N64-26140 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillion-sous-Bagneaux
OPTICAL MEASUREMENT OF HIGH TEMPERATURES [MESURE OPTIQUE DES TEMPERATURES ELEVEES]
Lionel Nadaud and Monique Gicquel *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 281–297 refs in FRENCH (See N64-26126 18-01)

The O.N.E.R.A. method for measuring the temperatures of flames, not exceeding 3,000° K, is described. The method is based on the principle of spectral-ray reversal. The recording of the temperature at detonation, by a shock wave, of a mixture of air and hydrocarbon, as well as the recording of the temperature at the nose of a model placed in the hypersonic flow of a hotshot wind tunnel is presented, and the precision of measurements is discussed. This method can perhaps be extended to temperatures in the neighborhood of 10,000° K through the use of a standard of brilliance of 5,000° K. Results indicating this possibility were obtained in an arc plasma jet. The time of response of the measuring instrument, on the order of 10^{-5} sec, permitted the observations of phenomena of very short duration. Trans. by I.v.L.

N64-26143 ARO, Inc., Arnold Air Force Station, Tenn.
STATUS OF DEVELOPMENT OF HOTSHOT TUNNELS AT THE AEDC
J. Lukasiewicz, R. Jackson, and J. D. Whitfield *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 323–356 refs (See N64-26126 18-01)

The present status of the AEDC-VKF hotshot tunnels, resulting from development during the past two years, is reported. Development of arc chambers and instrumentation is described. Good quality force and pressure measurements are made at test section velocities of about 10,000 ft/sec. Correlation of heat-transfer rate and velocity measurements shows that heat-transfer rates can be measured to within ± 20%. Limitations of hotshot operation at high enthalpies, due to material problems and excessive heat losses, are discussed. Author

N64-26151 Institut Franco-Allemand de Recherches, St. Louis (France)
METHODS AND RESULTS OF STUDY OF HOT HYPERSONIC FLOWS BY MEANS OUTSIDE THE FLOW [METHODES ET RESULTATS D'ETUDE D'ECOULEMENTS HYPERSONIQUES CHAUDS PAR DES MOYENS EXTERIEURS A L'ECOULEMENT]
Andre Auriol *In* AGARD The High Temp. Aspect of Hypersonic Flow 1964 p 501–517 refs in FRENCH (See N64-26126 18-01)

Hot hypersonic flow was studied by three methods—visualization, luminescent emissions, and the utilization of centimeter or millimeter shock waves. These methods did not give local measurements, but gave, rather, a general view of the occurring phenomena. Thus, they permit the rapid measurement of existing phenomena. I.v.L.

N64-26155* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

MEASUREMENTS OF RADIATION FROM THE FLOW FIELDS OF BODIES FLYING AT SPEEDS UP TO 13.4 KILOMETERS PER SECOND

Thomas N. Canning and William A. Page *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 569–582 refs (See N64-26126 18-01)

The radiation from hot air is discussed in qualitative terms of the physical and chemical processes responsible. The effects of electronic excitation, dissociation, ionization, and subsequent recombination are described. It is emphasized that the reaction rates for the above processes may be so low that important departures from thermodynamic and chemical equilibrium may exist in important regions of the flow fields of vehicles entering the atmosphere upon return from the moon. The integrated effects of these sources of radiation are deduced from photometric measurements of the radiation from the shock layers of small bodies fired from light-gas guns. The test velocity range extended to 13.4 km/sec through air of widely varied density. The variation of total radiated power is presented as a function of free-stream density and at velocities of 6.1, 9.1, and 12.5 km/sec. Reasonable agreement with calculations for equilibrium flow at free-stream densities above 0.04 standard atmosphere is shown. At lower densities the radiation exceeds greatly that calculated because of nonequilibrium effects in the shock layer. The application of these data at low densities to the estimation of radiative heating in full-scale flight is discussed. The measurements of radiation presented for wavelengths greater than about 0.5μ disclose important radiation from the hot model surface and ablated material from plastic models. Ablation of the model surface appears to control the amount of radiation emitted from the wake to an even greater extent. Author

N64-26156 Avco Everett Research Lab., Everett, Mass.

HYPERSONIC HEAT TRANSFER IN THE AIR LAMINAR BOUNDARY LAYER

James A. Fay *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 583–605 refs (See N64-26126 18-01)

A review is given of the methods and data used in computing the transport properties in a laminar boundary layer in air on a vehicle moving at velocities as great as 50,000 ft/sec. Particular attention is given to the problem of determining the transport properties of partially ionized air. Comparisons are made of the transport properties estimated by various authors as well as the heat transfer determined from the solution of the laminar boundary layer equations for stagnation point flow; the latter are compared with some experimental measurements. Author

N64-26157* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

RADIATIVE HEATING OF VEHICLES ENTERING THE EARTH'S ATMOSPHERE

Bradford H. Wick *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 607–627 refs (See N64-26126 18-01)

This paper considers the problem of calculating the equilibrium radiative heating of vehicles entering the Earth's atmosphere at velocities up to twice satellite velocity, with particular attention given to the cases of manned vehicles returning from trips to the Moon and Mars. Information and methods pertinent to the calculation of equilibrium radiative heating are presented and discussed. Numerical results are presented for evaluating stagnation-point heat flux and heat-flux distributions for spherical-segment noses for wide ranges of velocity and altitude. The results are for constant-energy shock layers of hot air that does not absorb radiation. The influence on stagnation-point radiative heat flux of absorption of shock-layer radiation, and the loss of shock-layer energy caused by the radiation are discussed and illustrated. Calculated values of stagnation-point radiative heat flux and total heat are presented for manned lunar and Mars vehicles, and are compared with corresponding values for convective heating. Author

N64-26158 General Electric Co., Philadelphia, Pa. Missile and Space Div.

HYPERSONIC ABLATION

L. Steg and H. Lew *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 629–680 refs (See N64-26126 18-01)

The severe high enthalpy environment generated by vehicles entering into atmospheres at hypersonic speeds has led to the consideration of material ablation as a means of alleviating the high heat flux. Refractory material, such as quartz, upon exposure to high enthalpy environment softens, melts, and flows under the influence of gas-shearing action. A fraction of the melt vaporizes and is introduced into the boundary layer. The behavior of this melt is complicated, of course, by body forces due to deceleration and to instability at the liquid-air interface. In another class of materials such as Teflon, the intermediate liquid phase is not present, and sublimation of the solid occurs directly. This type of material sublimes at a surface temperature and, through a depolymerization process, a monomer is formed that reacts with the environmental constituents of dissociated air species. At high surface temperatures the plastics, such as those represented by a phenolic resin reinforced with nylon or by a foamed polyurethane, are proven ablators. A thin layer of plastic is affected by the high heat flux due to its low thermal conductivity. Characteristics of the behavior of this class of material are the char layer formed from the depolymerization process within the plastic and the generation of gases represented by methane, hydrogen, etc. Further complication occurs due to the oxidation process at the surface of the char with the dissociated air species. Refractory material, as graphite, ablates by the oxidation process and is affected by the mass transfer and heterogeneous reactions at its surface. It was demonstrated that these classes of material are useful for the survival of materials in reentry environment. This survey paper reviews the behavior of these materials from an experimental and theoretical point of view. Some interesting areas for further investigation are pointed out. Author

N64-26159 College of Aeronautics, Cranfield (Gt. Brit.)

THE EFFECT OF CATALYTIC SURFACES ON STAGNATION POINT HEAT TRANSFER IN PARTIALLY DISSOCIATED FLOWS

J. R. Busing *In* AGARD The high Temp. Aspects of Hypersonic Flow 1964 p 681–691 refs (See N64-26126 18-11)

Experimental results are presented that show that the heat-transfer rate to a silicon monoxide coated surface is less than that to a platinum surface when the flow outside the boundary layer is partially dissociated. The recombination coefficient for the platinum surface used in these tests lies between 6×10^{-4} and 6×10^{-3}. It was concluded, from one particular set of tests that the flow in the stagnation region was not in equilibrium and was only half dissociated. Suggestions are made for the construction of a probe to measure atom concentrations and relaxation times in short duration flows. Author

N64-26283 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Munich (W. Germany) Institut für Flugtreib- und Schmierstoffe

THERMODYNAMIC EVALUATION OF PERFORMANCE DATA OF ROCKET PROPELLANTS [THERMODYNAMISCHE BERECHNUNG DER LEISTUNGSDATEN VON RAKETENTREIBSTOFFEN]

G. Spengler, E. Büchner, A. Lepie, and H. Gemperlein (Technische Hochschule München) [1963] 23 p refs Repr. from Brennstoff-Chemie (Essen), v. 44, no. 7, Jul. 1963 p 217–224; v. 44, no. 9, Sep. 1963 p 268–275

(DVL-300)

A method for calculating theoretical performance data of rocket propellants is described and applied, in particular, to a propellant combination of 90 wt % benzene and 10 wt % toluene, plus nitric acid as an oxidizer. Complete combustion and simultaneous resumption of equilibrium are assumed. The calculations were utilized for a closer investigation of specific impulse, the mass flow coefficient, and thrust factor. Trans. by I.v.L.

N64-26335 Purdue U., Lafayette, Ind. School of Aeronautical and Engineering Sciences

RADIATION TRANSFER REGIMES IN HYPERSONIC FLIGHT

R. Goulard *In* AGARD Supersonic Flow, Chem. Processes and Radiative Transfer 1964 p 307–318 refs (See N64-26326 18-11)

(Grant NSF G-23710) Pergamon: £ 9

A dimensionless analysis of the shock layer of very high speed objects in a planetary atmosphere (space probes, meteors) shows that two parameters determine the nature of the radiation transfer processes involved—the optical thickness of the shock layer τ and the radiation-convection ratio Γ. Several asymptotic solutions corresponding to small and large values of τ and to small values of Γ are discussed. They illustrate the variations to be expected in the shock layer structure and in the radiation it releases. In particular, it can be shown that for certain optimum values of τ, the shock layer thickness is expected to reach a minimum value. The flight areas where these phenomena appear are plotted in the altitude–velocity diagram of an ideal atmosphere, and nonequilibrium effects are similarly indicated. A sizable flight domain exists where blackbody radiation is an adequate estimate of the heat flux to the stagnation point. Author

N64-26336 New York U., N.Y.

THE INFLUENCE OF RADIANT-ENERGY TRANSFER ON ONE-DIMENSIONAL SHOCK WAVE PROPAGATION

D. B. Olfe *In* AGARD Supersonic Flow, Chem. Processes and Radiative Transfer 1964 p 355–374 refs (See N64-26326 18-11)

(Grant NSF-GP-562) Pergamon: £ 9

A theoretical analysis of the effect of radiative transfer on the flow field and propagation velocity of a one-dimensional shock wave is carried out for the case of a radiation flux that can be treated as a perturbation. The effects of self-absorption, external radiation sources, and absorption or radiation ahead of the shock are included for frozen or equilibrium flow. The equations of motion reduce to wave equations for the perturbation gas velocity and pressure with space and time dependent source functions determined by the radiative transfer and boundary conditions (shock relations at the shock front). For the case of a shock reflected from a plane wall the perturbation flow variables and shock propagation velocity are determined in terms of integrals of the radiant-energy flux. Explicit results are obtained for a transparent (optically thin) gas and for a gray gas. Author

N64-26354* Little (Arthur D.) Inc., Cambridge, Mass. Jet Propulsion Lab., Calif. Inst. of Tech.,

DESCRIPTION OF A TRANSIENT THERMAL ANALYSIS PROGRAM FOR USE WITH THE METHOD OF ZONES Report No. II

Wilbur K. Sepetoski, Carol H. Sox, and Peter F. Strong Aug. 1963 41 p ref Prepared for JPL

(Contract NAS7-100)

(NASA-CR-56722; C-65670) OTS: $4.60

A program was written, and from time to time modified, to solve numerically the differential equations that arise when the method of zones is used to construct a mathematical model of the thermal behavior of a physical system. One particular feature of the program is that a number of checks are incorporated to improve the confidence in the input data and the results. Another feature is the use of an integration parameter, specified in the input data, to give control over the implicit integration procedure used. A description of the problem and the checking procedures is first given in this report. Then the detailed specifications of the input data are discussed, and a sample problem is presented. The outputs, both on-line and off-line, are described. The full details of the program, including a catalog of the storage contents, the FORTRAN coding, and the flow charts, are given. Author

N64-26361* Georgia Inst. of Tech., Atlanta

HEAT TRANSFER TO A GAS CONTAINING A CLOUD OF PARTICLES

Andrew Mc Alister, Henderson C. Ward, Alberto F. Hidalgo, and Clyde Orr, Jr. 25 Jun. 1964 47 p refs

(Grant NsG-273-62)

(NASA-CR-58088; SSR-4)

The radiant energy absorbed by particle clouds was measured while the clouds were flowing inside a quartz tube having energy from surrounding radiators being received through the wall. The energy absorbed by a cloud passing through the radiant field was determined by two energy-balance procedures. Results were obtained for aerosols of different size fractions of ferrous sulfide and cupric oxide. Research efforts have been directed toward evaluation, from low-temperature nitrogen-adsorption techniques of the surface properties of powders. R.T.K.

N64-26411* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

HEAT-TRANSFER AND WEIGHT ANALYSIS OF A MOVING-BELT RADIATOR SYSTEM FOR WASTE HEAT REJECTION IN SPACE

Richard J. Flaherty Washington, NASA, Aug. 1964 83 p refs

(NASA-TN-D-1990) OTS: $2.25

A theoretical analysis of a moving-belt radiator system was conducted in which waste heat is transferred to the belt by contact with the outer surface of a rotating or stationary drum in which the working fluid is condensing. An eigenvalue solution for the conductive heat transfer from the condensing vapor through the drum wall and the drum-belt interface into the belt is derived and compared with a simplified approximation. A parametric analysis of the drum-belt system weight (per unit heat-radiation rate) was conducted to indicate the influence of the major design variable involved. Author

N64-26469 Lockheed Missiles and Space Co., Sunnyvale, Calif.

APPLICATION OF THERMAL NETWORK ANALYZER PROGRAM TO NUCLEAR-ENGINE HEAT-TRANSFER PROBLEMS

Chuk C. Ma 18 Jun. 1963 20 p refs
(NSP-63-76)

Application of the thermal network analyzer program for temperature distribution calculations of the nuclear core and nonnuclear components of a nuclear rocket engine is illustrated. The necessity for modifying part of the input data to fit the various types of nuclear engine heat flow problems into the program in its present form is described. Proper application of various functions provided by the program is also discussed. Author

N64-26483 Argonne National Lab., Ill. Reactor Engineering Div.
APPLICATION OF ELECTRON-BOMBARDMENT HEATING FOR BOILING LIQUID METALS
R. E. Holtz Mar. 1964 18 p refs
(Contract W-31-109-ENG-38)
(ANL-6869) OTS: $0.50

The problem of obtaining a curve of the heat flux vs temperature difference for boiling liquid metals is discussed. Various heating techniques are discussed, with special emphasis given electron-bombardment heating. Electron-bombardment heating will supply high uniform heat fluxes to liquid metals at high temperatures. Author

N64-26508 National Bureau of Standards, Washington, D.C.
HEATS OF FORMATION OF METALLIC BORIDES BY FLUORINE BOMB CALORIMETRY Technical Documentary Report, 1 Oct. 1961–30 Sep. 1963
Eugene S. Domalski and Goerge T. Armstrong Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Mar. 1964 74 p refs
(Contract AF 33(616)-6109)
(NBS-8153; APL-TDR-64-39; AD-600396)

For reactions (1) and (2), the values of ΔH^{298} were found.

$$Al\,B_{2.215} + 9.645\,F_2(g)/2 = Al\,F_3(s) + 2.215\,BF_3(g) \quad (1)$$

$$\alpha - Al\,B_{11.96}(s) + 38.87\,F_2(g)/2 = Al\,F_3(s) + 11.96\,BF_3(g) \quad (2)$$

respectively, to be −923.5 and −3,546.2 kcal mole $^{-1}$, respectively. Uncertainties of the heats of formation, estimated as the standard deviations of the means, are 2.1 and 1.8 kcal mole, respectively. The samples were completely analyzed and carefully characterized. Some combustion measurements on impure zirconium borides are reported. A review with 85 references is given of the available thermodynamic data on borides. Author

N64-26553 Technische Hochschule Fridericiana, Karlsruhe (W. Germany)
THEORETICAL BOUNDARY-LAYER RESEARCH ON THE PROBLEM OF HEAT TRANFER THROUGH STEADY AND COUNTER FLOWS [GRENZSCHICHTTHEORETISCHE UNTERSUCHUNGEN ZUM PROBLEM DES WARMEAUSTAUSCHES BEI GLIECHSTROM UND GEGENSTROM]
Wolfgang Tolle (Ph.D. Thesis) Apr. 1964 122 p refs In GERMAN
(Sponsored by Deutsche Forshungsgemeinschaft)

Heat transfer on a flat plate and on a pipe wall, in steady and counter flows, was theoretically investigated for laminar and turbulent flows on each side of the boundary surface. The equations derived from theoretical boundary-layer investigations for heat transfer on a wall of constant temperature can, by superposition, be applied to walls of variable temperature. The local wall temperatures, the local heat-flux density, and the local Nusselt numbers were calculated for heat transfer in steady and counter flows. The results obtained for the heat transfer on a flat plate were compared to an equation of Johnson and Rubesin. A modified equation of Jakob and Dow was used to compare the results obtained for the heat transfer on a pipe wall. And investigation was conducted to ascertain if the Nusselt number on one side of the heat-transferring surface was dependent upon the flow condition on the opposite side. I.v.L.

N64-26580* General Electric Co., Cincinnati, Ohio Missile and Space Div.
ALKALI METALS BOILING AND CONDENSING INVESTIGATIONS, VOLUME I Quarterly Progress Report No. 6, Oct. 1–Dec. 31, 1963
J. Longo, Jr. ed. 20 Apr. 1964 299 p refs
(Contract NAS3-2528)
(NASA-CR-54037) OTS: $18.50 ph

A program conducted to obtain two-phase heat-transfer data for sodium and potassium under conditions of boiling and condensing is reviewed. The program also includes the obtaining of information related to pressure drop and flow stability, as well as test development and materials studies pertinant to the experimental work to be conducted. Experimental data obtained with 300-, 100-, and 50-kw test facilities are included. P.V.E.

N64-26589* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
FREEZING OF LIQUIDS ON SUDDEN EXPOSURE TO VACUUM
John B. Gayle, Carl T. Egger, and James W. Bransford Repr. from J. Spacecraft and Rockets, v. 1, no. 3, May–Jun. 1964 p323–326 refs
(NASA-RDRP-249)

This is an analysis of evaporative cooling and freezing of liquids in a vacuum. Preliminary consideration of the mechanism of the process resulted in a complex mathematical model. Therefore, it was necessary to make a number of simplifying assumptions to establish material and energy balances that were used, along with the kinetic theory of gases, as a basis for calculations. Results given for several cryogens and water indicate the effects of initial temperature, drop diameter, and ambient pressure on the time required for cooling to the triple point and subsequent freezing. IAA

N64-26687 Purdue U., Lafayette, Ind. School of Aeronautical and Engineering Sciences
APPLICATION OF IRREVERSIBLE THERMODYNAMICS IN FINITE VISCOELASTIC DEFORMATIONS
George Lianis Jan. 1964 29 p refs Prepared for Lockheed Propulsion Co.
(Contract AF 94(611)-8539)
(A&ES-64-1; AD-438003)

Onsanger's principle of irreversible thermodynamics is applied to viscoelastic bodies subjected to finite deformation. The constitutive equation for small dynamic strains superposed on finite static deformation is used. The state of such deformation is considered as small deviations from an equilibrium reference state, the latter being that of equilibrium state of a material subjected to finite deformation in which the material is maintained for a long time. Author

N64-26707* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
NONLINEAR-AVERAGING ERRORS IN RADIATION PYROMETRY
Donald R. Buchele Washington, NASA, Aug. 1964 18 p refs
(NASA-TN-D-2406) OTS: $0.50

The error in measuring the average of a fluctuating temperature by optical means is determined for cases of temporal

or spatial fluctuation with small optical depth. The method is applicable to line-reversal, absorption-emission, and other pyrometric methods that involve the measurement of the absolute or relative magnitudes of radiant flux. It is also applicable to some techniques of gas analysis by radiometric means. Experimental confirmation of the analysis is described for a Gaussian probability density distribution. The analysis accounts for a previously reported discrepancy of a few percent between a line-reversal pyrometer and other types of local (probe-type) pyrometers. Author

N64-26733 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
JOURNAL OF ENGINEERING PHYSICS Selected Articles
28 Jan. 1963 24 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 5, no. 3, 1962 p 45–50, 66–71
(FTD-TT-62-1568/1+2+4; AD-295810)

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1. CALCULATING THE TEMPERATURE FIELDS IN THE BUCKET OF A GAS TURBINE COOLED THROUGH SLOTS IN THE ASSEMBLY Ye. I. Molchanov p 1–11 refs
2. A STUDY OF THE ELECTRICAL CONDUCTIVITY OF A FLAME BY THE MICROWAVE METHOD E. P. Zimin and V. A. Popov p 12–21 refs

N64-26774* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HEAT TRANSFER ON UNSWEPT AND 38° SWEPT CYLINDRICALLY BLUNTED WEDGE FINS IN FREE FLIGHT TO MACH NUMBER 4.11
Floyd G. Howard Washington, NASA, Aug. 1964 50 p refs
(NASA-TN-D-2386) OTS: $1.25

Heat-transfer measurements were obtained on the cylindrically blunted leading edge and along the midspan chord of unswept and of 38° swept wedge-section fins in free flight for a Mach range from 1.70 to 4.11. Free-stream Reynolds numbers per foot varied from 8.2×10^6 to 16.5×10^6. Comparison of theoretical and experimental heat-transfer results indicates that the boundary layer over the cylindrically blunted leading edge of the unswept fin was laminar throughout the test. On the 38° swept fin, the boundary layer was turbulent at free-stream Reynolds numbers (based on leading-edge diameter) as low as 0.362×10^6 and appears to have been turbulent throughout the test with Reynolds numbers as low as 0.256×10^6. On the leading edge, the laminar and the turbulent heat transfer at the stagnation line of the unswept and the swept fin, respectively, were in good agreement with theories for a yawed cylinder. On the unswept leading edge 45° from the stagnation line, the laminar theories were in fair agreement with data. On the 38° swept leading edge 45° from the stagnation line and at the tangency point of both leading edges, the data were considerably higher than the theories. The laminar and turbulent heating on the wedge surfaces were in fair agreement with flat-plate theory. Local transition Reynolds numbers on the wedge surface of the unswept fin varied between 0.65×10^6 and 4.63×10^6, with transition reversal occurring when the ratio of wall temperature to local stream temperature was lowest. Author

N64-26778* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
ANALYSIS OF FULLY DEVELOPED LAMINAR HEAT TRANSFER IN THIN RECTANGULAR CHANNELS WITH HEATING ON THE BROAD WALLS EXCEPT NEAR THE CORNERS
Joseph M. Savino, Robert Siegel, and Edward C. Bittner Washington, NASA, Aug. 1964 27 p refs
(NASA-TN-D-2411) OTS: $0.75

An analysis is presented of convective heat transfer in thin rectangular channels such as those commonly found in nuclear-reactor fuel assemblies. The velocity and temperature profiles are both assumed to be fully developed. Heating takes place in the fueled region located on the broad channel sides, but the fuel extends only part way to the corners. The short sides and portions of the broad sides that are not fueled are assumed insulated. The wall temperature distributions are shown to be strongly dependent on the spacing between the heated region and the corners. For uniform heating the maximum wall temperature shifts rapidly from the corner to the center of the broad side, as this spacing is increased from zero to only one-half the distance between the broad sides. With a cosine heating distribution where the peak flux is at the fuel edges, the wall temperature gradients are more severe than for the uniform heating case. Tables of temperature distributions in the fluid are also given. Author

N64-26780* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
HEAT TRANSFER FOR LAMINAR SLIP FLOW OF A RAREFIED GAS BETWEEN PARALLEL PLATES WITH UNSYMMETRICAL WALL HEAT FLUX
Robert M. Inman Washington, NASA, Aug. 1964 33 p refs
(NASA-TN-D-2421) OTS: $1.00

An analysis was made to determine the effects of low-density phenomena on the forced convection heat-transfer characteristics for fully developed laminar flow in a parallel plate channel for unsymmetrical heating involving a constant heat flux along each of the walls. Consideration is given to the slip-flow regime wherein the major rarefaction effects are manifested as velocity and temperature jumps at the channel walls. The results obtained apply along the entire length of the channel. The solution contains series expansions, and analytical expressions for the complete sets of eigenvalues and eigenfunctions are presented. The results give the wall temperatures and the thermal entrance lengths for the channel for various mean free paths and wall heat flux ratios. The results indicate that, in general, the thermal entrance length is decreased with increasing gas rarefaction and also that for a given mean free path the thermal entrance length is greater for unsymmetrical heating than for a symmetrical wall heat flux. Extension of the results is made or indicated to account for less frequently considered slip effects, such as wall shear work, modified temperature jump, and thermal creep velocity. Author

N64-26802 Ling-Temco-Vought, Inc., Dallas, Tex. LTV Research Center
THERMODYNAMIC PROPERTIES OF HIGH TEMPERATURE HELIUM
J. C. Hester and K. G. Sewell Aug. 1963 60 p refs
(Rept.-0-71000/3R-11)

The thermodynamic properties of helium were calculated for a range of temperatures from 2,000° to 100,000° K and for a range of density ratios based on standard atmospheric density from 10^{-10} to 10^2. The data are presented in charts that include enthalpy, entropy, pressure, specific heats, speed of sound, compressibility factor, and species concentrations. Author

14 HUMAN BEHAVIOR

Includes crew training and evaluation; piloting; and psychological factors. *For simulators see*: 10 Facilities, Research and Support. *For related information see*: 16 Life Sciences.

N64-25950* Republic Aviation Corp., Farmingdale, N.Y.
BIOMEDICAL AND HUMAN FACTORS REQUIREMENTS FOR A MANNED EARTH ORBITING STATION
W. Helvey, C. Martell, J. Peters, G. Rosenthal, F. Benjamin et al Washington, NASA, 3 Jan. 1964 442 p refs
(Contract NASw-776)
(NASA-CR-56021) OTS: $22.25 ph

Space environmental factors that are believed to have a significant effect on man were evaluated. These included those factors characteristic of the space environment (e.g., weightlessness, radiation) as well as those created within the space station (e.g., toxic contaminants, capsule atmosphere). An appraisal was made of the anticipated response of the astronaut to each of these factors. Also, the major organ systems and functions of the body were delineated, and a determination was made of their anticipated response to each of the environmental categories. A judgment was then made on the medical significance or importance of each response. This enabled a determination of which physiological and psychological effects should be monitored. Concurrently, an extensive list of measurement techniques and methods of data management were evaluated for applicability to the space-station program. Various space-station configurations and design parameters were defined in terms of the biomedical and human-factors requirements necessary to provide the measurements program. Research designs of experimental programs for various station configurations, mission durations, and crew sizes were prepared, and a trade-off analysis of the critical variables in the station planning was completed that contains recommendations to enhance the confidence in the measurement program. I.v.L.

N64-26000 Flying Personnel Research Committee (Gt. Brit.)
HAND PREFERENCE IN AIRCREW: A STUDY OF THE CONSISTENCY AND STRENGTH OF LATERAL PREFERENCE FOR SIMPLE UNIMANUAL TASKS
J. L. Gedye Air Ministry, Nov. 1963 19 p refs
(FPRC/MEMO-203)

A preliminary account of an investigation designed to provide more information about the likely importance of laterality factors for the understanding of difficulties in flying was conducted. A comparative study of hand preference patterns in groups of pilots at different stages of training indicates that there is some relationship between hand preference pattern and flying skill. Both the consistency and strength of lateral preference are important. R.T.K.

N64-26025 Aerojet-General Corp., Sacramento, Calif.
HUMAN RELIABILITY IN THE PERFORMANCE OF MAINTENANCE
Irl A. Irwin, Joel J. Levitz, and Alvyn M. Freed May 1964 71 p refs
(Contracts AF 04(694-424, Suppl. Agreement 24; AF 04 (647)-521)
(LRP-317/TDR-63-218; AD-600176)

A method for estimating the reliability of maintenance performance is developed and applied to tasks involved in scheduled maintenance for Titan II engines. The approach involves the combined use of ratings and empirically derived reliability figures. A modification of the design engineer's redundancy formula is developed for estimating the increase in human reliability achieved when two mechanics work together in the performance of a single maintenance task. This study demonstrates that highly consistent ratings of task element reliability can be obtained from groups of qualified raters. Author

N64-26053 Indiana U., Bloomington
ELECTROPHYSICAL EFFECTS OF SHORT-TERM SENSORY DEPRIVATION
Robert M. Stern Nov. 1963 16 p refs
(Contract Nonr-908(15))
(TR-9; AD-437810)

It was the purpose of this study to investigate the effects of two different sensory deprivation situations for a period of one hour. The effects were measured in terms of the electrophysiological activity of the autonomic nervous system and the skeletal muscle group. A vigil group reported the movements of an autokinetic light, while a rest group simply relaxed. The autonomic indices revealed significantly higher somatic activity for the vigil group, thus supporting Malmo's hypothesis concerning the importance of task demands in determining the level of physiological activity. G.D.B.

N64-26235 Naval Ordnance Test Station, China Lake, Calif.
AIRCRAFT RANGES FOR TRAINING PILOTS IN SPECIAL-WEAPON-DELIVERY TECHNIQUES
Everett B. Hill Jun. 1964 40 p refs
(NOTS-TP-3346; NAVWEPS-8414; AD-443069)

This report describes in detail the instrumentation necessary for training aircraft pilots in special-weapon delivery techniques. The essential elements of the system are a tracker–plotter to outline the path of the aircraft in a vertical plane at the flight line and a telescope skyscreen to accurately measure the aircraft's speed while performing these maneuvers. Author

N64-26237 Naval Air Development Center, Johnsville, Pa. Aviation Medical Acceleration Lab.
PLOTTING AND ANALYZING CUMULATIVE RESPONSE CURVES IN OPERANT CONDITIONING STUDIES
Robert M. Herrick 2 Jun. 1964 31 p
(NADC-ML-6406; AD-602477)

Because the response and time scales typically used in plotting cumulative response curves are poorly selected, ineffective displays often result. The visual cue of a rate change is the difference, $\overline{\Delta\Theta}$, between the angles, Θ_1 and Θ_2, representing the two rates, R_1 and R_2. These variables are related by: $\tan \Theta_2 = R_2/R_1 \tan \Theta_1$. For a given rate change, the value of Θ_1, viz., ${}_M\Theta_1$, that yields the maximum value of $\overline{\Delta\Theta}$, viz., $\overline{\Delta\Theta}_{max.}$ is given by ${}_M\Theta_1 = \text{arc sin } (R_1/R_1 + R_2)^{1/2}$. Ideally, the initial response rate should be represented by the ${}_M\Theta_1$ appropriate for a given rate change. Because of practical considerations, however, some compromises with the ideal are allowable. Included in the discussion are steps required to select appropriate response and time scales, with examples, and guideposts for evaluating rate changes by means of angular changes. Author

N64-26278 Indiana U., Bloomington
LONG-TERM OBSERVATION OF THE AUTOKINETIC ILLUSION: FREQUENCY AND DIRECTION OF MOVEMENT
Robert M. Stern Jan. 1964 11 p refs
(Contract Nonr-908-15)
(TR-10; AD-437811)

This study was designed to test reports of autokinetic movement increase with increasing exposure time and reports of movement in the vertical plane occurring with greater frequency than reports of movement in the horizontal plane. Forty subjects, who were told that they were radar watchkeepers, observed a pin point of light in a dark room for 30 min and indicated the direction of apparent movement. The results obtained supported both hypotheses. The increase in reports of

movement is accounted for in terms of increased suggestibility due to the effects of sensory deprivation. A possible explanation for the greater frequency of reports of vertical movement is discussed in terms of Kunnapas' theory of the relevance of the horizontally extended oval shape of the visual field for the horizontal–vertical illusion. Author

N64-26544* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MEASUREMENTS OF HUMAN TRANSFER FUNCTION WITH VARIOUS MODEL FORMS
James J. Adams and Hugh P. Bergeron Washington, NASA, Aug. 1964 35 p refs
(NASA-TN-D-2394) OTS: $1.00

Human transfer functions, relating the pilot's visual input (i.e., the displayed error) to his stick controller output, were measured by using an automatic model matching technique. In this method, several gains in an analog model with a fixed, preselected form are automatically adjusted to provide the best match to the time history of the pilot's output. In the present investigation input and output data recorded on magnetic tape were analyzed several times with different model forms to determine whether one form had an advantage over another. The different forms included various amounts of fixed time delay and various arrangements of the gains in the linear portion of the model. Time histories of the outputs, closed-loop characteristics calculated by using the measured transfer functions, and system errors obtained with the model in the loop were examined. Results showed no particular advantage for any one model over all the others. The close agreement in results obtained with several of the models indicates that a good linear model for a human pilot was obtained. Results also indicate that using this model gives smaller system errors than using a pilot. Author

N64-26675 Royal Inst. of Tech., Stockholm (Sweden) Speech Transmission Lab.
[SPEECH ANALYSIS AND PERCEPTION] Quarterly Progress and Status Report No. 13, July–September 1963
Gunnar Fant 15 Oct. 1963 43 p refs
(Contract DA-91-591-EUC-3080; Grants AF-EOAR-63-55; NIH-G-NB-04003-01)
(STL-QPSR-3(1963); AFCRL-64-15; AD-439617)

The following studies are discussed: (1) speech analysis—spectrograms of U. C. Swedish stops, and spectrum envelopes for synthetic vowels; and (2) speech perception—a study in French intonation. R.T.K.

N64-26765 Joint Publications Research Service, Washington, D.C.
ON THE CYBERNETIC APPROACH TO THE PROBLEM OF IMAGE
L. M. Vekker and M. G. Yaroshevskiy 6 Aug. 1964 12 p Transl. into ENGLISH from Vopr. Filosofii (Moscow), no. 5, 1964 p 173–177
(JPRS-25761; TT-64-41032) OTS: $1.00

The cybernetic approach to the problem of the sensual image and perception is discussed, and the dialectic-materialistic theory of image is presented. R.T.K.

N64-26852 Cincinnati U., Ohio Behavioral Sciences Lab.
A TEST OF TROUBLESHOOTING STRATEGY IN PAPER-PENCIL FORM
R. J. Senter and Frank Nairne Wright-Patterson AFB, Ohio, AMRL, Jul. 1963 9 p
(Contract AF 33(616)-7674; AF 33(616)-6835)
(AMRL-MEMO-P54; AD-417419)

As an adjunct to research on transfer of troubleshooting skill, a paper-and-pencil Troubleshooting Simulation Test (TST) was developed. This test was administered to subjects in an attempt to obtain validating data regarding the potential value of such tests for the selection of personnel most suited for learning to troubleshoot. The TST consisted of 13 items. Each item was composed of several (3 to 32) overlapping geometric figures. The points of union of the various figures were marked with an X. The subjects' task was to discover the mystery figure (known only to the experimenter) by sequentially selecting X's. A given figure could contain many X's, sharing each with different overlapping figures. The subject was informed whether or not the selected X was within the mystery figure. Performance on the TST correlated significantly with some measures of learning to troubleshoot some equipment. Support was evidenced for the concept of a paper-and-pencil simulation of troubleshooting test for selecting personnel for certain troubleshooting tasks. Author

N64-26874 Air Force Systems Command, Wright-Patterson AFB, Ohio Aerospace Medical Div.
THE EFFECT OF SIMULATED AIRCRAFT SPEED ON DETECTING AND IDENTIFYING TARGETS FROM SIDE-LOOKING-RADARIMAGERY Technical Documentary Report, Sep.-Dec. 1963
H. C. Self and Fen Rhodes May 1964 23 p refs
(AMRL-TDR-64-40; AD-603014)

Operator performance in detecting and identifying airfields, bridges, dams, and railroad yards from side-looking radar imagery was tested. The imagery was presented to four college students on a 14 by 14-in. screen at speeds representing Mach 0.9, 1.6, 2.3, and 3.1. An average of 65% of the targets was identified. Percentage of false targets varied significantly between subjects and ranged from 42% to 64%. A slight but consistent trend toward more detections at slower speeds was not found to be statistically significant. The number of false positive responses was not significantly affected by image speed. No decrement in performance could be found as a result of extended (3 hours maximum) trial duration. Author

N64-26884 Radio Corp. of America, Princeton, N.J. RCA Labs.
TWO-MODE THRESHOLD LEARNING Technical Documentary Report, May 1963–Oct. 1963
J. Sklansky Wright-Patterson AFB, Ohio, Aerospace Med. Res. Labs., May 1964 60 p refs
(Contract AF 33(657)-11336)
(AMRL-TDR-64-39; AD-602966)

In certain threshold learning processes (TLPs) associated with pattern recognition and sensory perception, the process of training an observer to recognize patterns or distinguish levels of sensory excitation may be modeled by a finite-state Markov chain. When the statistics of the signals received by the observer move at random between two sets of parameters, a two-mode TLP is obtained, modeled by a two-mode Markov chain. Using a probabilistic measure of effectiveness, the effectiveness of a simple incremental feedback policy is shown to be greater for two-mode TLPs than for one-mode TLPs over a certain range of environmental and structural statistics. A method of designing periodic train–work schedules for two-mode TLPs is described. (Train and work correspond to closed-loop and open-loop, respectively.) In many real adaptive processes an RC approximation of the train–work dynamics is applicable. For these processes the ratio of working time to retraining time, yielding a desired performance level, is maximized when the

work–retrain period is made as small as possible. Many stochastic processes present modeling problems of near psychological complexity. Ways in which open-loop–closed-loop relationships can help the life scientist or engineer model adaptive stochastic processes by two-mode TLP's are indicated. Author

N64-26892 Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
FURTHER EXPERIMENTS ON COMPUTER-AIDED LEARNING OF SOUND IDENTIFICATION
John A. Swets, Judith R. Harris, Linda S. Mc Elroy, and Harry Rudloe Apr. 1964 53 p refs
(Contract N61339-789)
(NAVTRADEVCEN-789-2; AD-602076)

Earlier experiments on computer-aided teaching of the identification of nonverbal sounds showed an extremely simple procedure to be more effective than the procedures of automated or programed instruction. Specifically, a procedure in which the sound-label pairs are just presented and observed, in random order, was superior to procedures that employed various configurations of continual interrogation, overt response, immediate knowledge of results, presentation of items in a developmental order, and presentation of successive items conditional upon previous performance. Granting to the subject control of the training procedure led to no better final performance than that observed when the experimenter determined the course of the lesson, and the scope-and-light-pen device led to no better performance than the typewriter. Further analysis of the results provides detailed support of the earlier conclusions—for example, success was positively correlated with the proportion of time spent on simple exposure to the sound-label pairs, and negatively correlated with the proportion of time spent in active responding, receiving feedback, and making second tries. Three variables related to streamlining of the task and the temporal contiguity of sound and label account for nearly 100% of the variance. Author

N64-26953 Massachusetts U., Amherst Inst. of Environmental Psychophysiology
VISUAL AFTER-IMAGES AS A SOURCE OF INFORMATION
Warren H. Teichner and Mahlon Wagner 11 Jun. 1964 45 p refs
(Contract N61339-1303)
(NAVTRADEVCEN-1303-3; AD-603546)

The data-acquisition advantage afforded the human receiver by increasing the exposure time of briefly glimpsed, visual-display material is discussed. Under viewing conditions, the retinal afterimages of such material were found to add enough viewing time (about 10 to 15 seconds) to substantially improve the subjects report of what they had seen. For single glimpse situations, it is established that the observer sees more than he is able to report. The afterimage takes on two forms. Immediately following stimulation of the eye by the flashing of an image, there generally appears a positive afterimage that, in the absence of the stimulus, has the same contrast and color relations as the original image. The negative afterimage, which follows the positive, contains complementary color and has a much longer duration. J.L.C.

N64-26960 Hughes Aircraft Co., Culver City, Calif.
THE MEASUREMENT OF STIMULUS COMPLEXITY IN HIGH-RESOLUTION SENSOR IMAGERY
J. E. Nygaard, G. K. Slocum, J. O. Thomas, J. R. Skeen, and J. G. Woodhull Wright-Patterson AFB, Ohio, AMRL, May 1964 290 p refs
(Contract AF 33(657)-9477)
(AMRL-TDR-64-29; AD-603007)

A stimulus complexity analyzer was built and used to obtain measures of overall background complexity on several types of high-resolution reconnaissance imagery. These measures were then compared to target recognition performance in a series of studies using Side Looking Airborne Radar (SLAR), infrared (IR), and aerial photographic imageries. Significant relationships between a number of analyzer measures and recognition performance were obtained. For the photo and IR imagery backgrounds studied, a perfect curvilinear relationship was obtained between analyzer measures of total object count and recognition performance. Inverse relationships were obtained between target recognition time and mean object size and object size variance for the SLAR, IR, and photo backgrounds. These relationships were more obvious with the photo and IR imageries than with the SLAR imagery. Although these relationships should be considered tentative, they are encouraging. In addition to the development and experimental use of the stimulus complexity analyzer, a technique for embedding targets in different backgrounds was developed and used. It allowed the effects on performance of target differences, background differences, and target-by-background interaction to be studied. Author

15 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; sensors and transducers; and telescopes and cameras. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.

N64-25879* Massachusetts Inst. of Tech., Cambridge Electronic Systems Lab.
REDUCTION OF ERRORS IN VIBRATORY GYROSCOPES BY DOUBLE MODULATION
Richard W. Bush and George C. Newton, Jr. Repr. from IEEE Transactions, Session 18, Paper 1 [1963] p 521–529 refs
(Grant NsG-149-61)

Vibratory-drive–vibratory-output instruments for sensing angular rates, such as tuning forks, potentially offer certain advantages over conventional gyroscopes. The theoretical performance of these devices has not been realized experimentally because of zero-rate errors attributed to mass unbalance, driving force unbalance, and other imperfections. By separating the driving and sensing frequencies through an additional rotation or vibration of the basic sensing element, zero-rate errors may be diminished. Theoretical and experimental evidence in support of the double modulation concept is presented. A tuning fork type of instrument has been used in the initial experiments, and a substantial improvement over the performance of the same instrument without double modulation has been realized. Author

N64-25890 California U., Livermore Lawrence Radiation Lab.
AN IMPULSE ACCELEROMETER
William E. Nelson, Jr. and G. Wayne Brown 12 Mar. 1964 32 p refs
(Contract W-7405-ENG-48)
(UCRL-7766; TID-4500)

Contemporary accelerometers fall into two general categories, mechanical deformation and electronic transducer. The first type can be small and rugged but it has the electronic transducer. The first type can be small and rugged but it has the

disadvantage of reading out only an acceleration level, which must be regarded as a "figure of merit" depending on the relationship between the dynamic response of the accelerometer and the nature of the input excitation. The electronic transducers are capable of accurate acceleration input monitoring, if properly used, but require conditioning and readout equipment for which there often is no space or power. This report describes an accelerometer that offers some of the advantages of each of the above categories. It is relatively small and rugged and requires no conditioning or readout equipment during operation. Readout consists of an "equivalent" square wave with an acceleration level and pulse interval time. The instrument can be used to measure square wave accelerations directly, or, if a wave shape is known, its output data can be mathematically transformed to the type of "g-signature" actually measured. Author

N64-25929* National Aeronautics and Space Administration, Washington, D.C.
A STANDARD CUBICAL TELESCOPE
Ya. L. Blokh *In its* Cosmic Rays Jul. 1964 p 102–137 refs (See N64-25926 18-28) OTS: $4.00

The cubical telescope consists of two identical and independent telescopes with separate power supply and independent output-registration channels. The following are described: (1) arrangement of counters in the telescope; (2) directional diagrams of the components for a cubical telescope; (3) statistical accuracy of the components registered with a cubical telescope; (4) increasing the useful life of the counters; (5) follow-up high-voltage counter power supply; (6) choice of optimum resolving time for threefold coincidences; (7) automatic registration of cosmic-ray bursts and automatic control of operation of the cubical telescope; (8) meteorological coefficients of the μ-meson component for cubical and semicubical telescopes; (9) meteorological coefficients of the soft component for a semicubical telescope; (10) investigations of the variations of cosmic rays based on data obtained with cubical telescopes and other instruments; and (11) comparison of observed variations of the hard component, registered with a cubical telescope and an ionization chamber. R.T.K.

N64-25930* National Aeronautics and Space Administration, Washington, D.C.
AZIMUTHAL TELESCOPE FOR THE INVESTIGATION OF VARIATIONS OF COSMIC RAYS IN DEPENDENCE ON THE INCIDENT DIRECTION OF THE PRIMARY RADIATION
O. I. Inozemtseva and Yu. A. Kapitonov *In its* Cosmic Rays Jul. 1964 p 138–160 refs (See N64-25926 18-28) OTS: $4.00

The following are discussed: (1) working principle and basis of the block diagram of the azimuthal telescope; (2) quenching system; (3) choice of resolving time and arrangement of coincidence circuit; (4) amplitude discriminator and scaler; (5) choice of power supply; (6) instrument errors; (7) errors due to the mechanical construction of the instrument; (8) errors due to Geiger counters; and (9) errors due to the electronic circuits. R.T.K.

N64-25931* National Aeronautics and Space Administration, Washington, D.C.
REGISTRATION OF THE INTENSITY OF COSMIC RAYS WITH PLASTIC SCINTILLATORS
N. S. Kaminer *In its* Cosmic Rays Jul. 1964 p 161–176 refs (See N64-25926 18-28) OTS: $4.00

In calculating the directional diagrams for the plastic scintillator, it was assumed that the probability of registering a charged particle does not depend on its direction of incidence, and that the efficiency is constant over its entire area. This assumption holds true for telescopes with a large aperture angle, inasmuch as the operating regime of the discriminator is made such that relativistic particles arriving vertically, and hence giving a minimum pulse in the photomultiplier, are effectively registered. However, the efficiency of a plastic scintillator is somewhat reduced when a particle strikes it close to the outside edge. In this case, the total intensity of the registered particles will be somewhat reduced, but the directional properties of the telescope will increase. Directional diagrams for scintillation telescopes are included. R.T.K.

N64-25960* Micro-Erg Labs., Inc., Philadelphia, Pa.
ABSOLUTE PRESSURE GAUGE FEASIBILITY STUDY Final Report
20 Jun. 1963 123 p refs
(Contract NAS5-3212)
(NASA-CR-58075; MEL-C63-01) OTS: $10.10 ph

The results of a study of an ultra-high-vacuum pressure gage, in which the measurement of pressure is based upon momentum transfer between the gas molecules and the sensing device are summarized. The results of system selection studies are presented, and the feasibility, practicality, and potential utility of the recommended pressure gage are discussed. R.T.K.

N64-26030 Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.
A GAMMA RAY DETECTOR OF VARIABLE GEOMETRY FOR WHOLE BODY COUNTING OF SMALL ANIMALS
R. M. Goodrich, R. G. Thomas, and S. R. Wright Jul. 1964 21 p ref
(Contract AT(29-2)-1013)
(LF-14)

A gamma-ray detector for counting small animals in metabolism cages has been constructed. The cage is centered between horizontal coaxial NaI crystals. By varying the distance of separation between the crystals the counting efficiency of the detector for I^{131} can be varied from approximately 6% to 0.24%, making it possible to count a wide range of source activities. The detector is shielded by four inches of lead, which allows for considerable stability in background counting rates. Various aspects of the counter performance have been studied and are presented in graphical form with some discussion of the characteristics. These include determinations of efficiency as a function of crystal separation, gamma-ray energy, and point versus bulk source. A short treatment of the effect of scattering is also included. Author

N64-26091* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
THE USE OF A HELIUM MASS SPECTROMETER LEAK DETECTOR
Earle W. Young Washington, NASA, Jul. 1964 20 p refs (NASA-TM-X-978) OTS: $0.50

This document describes some fundamental theoretical and practical applications of the helium mass spectrometer leak detector in relation to vacuum chambers and particularly to items to be leak checked inside vacuum chambers. Of the three basic methods of leak detection—pressure testing, vacuum testing, and pressure-vacuum testing—only the latter is treated extensively. The leak detector output is derived as a function of the pressure of the helium or helium mixture behind the leak, as a function of helium concentration, and as a function of time. The results are discussed both quantitatively and qualitatively. Author

N64-26105 Aerospace Corp., El Segundo, Calif. Electronics Div.

BELL IIIB ACCELEROMETER EXPERIMENTS

R. S. Bovitz 15 May 1964 83 p

(Contract AF 04(695)-269)

(SSD-TDR-64-37; TDR-269(4250-33)-1; AD-602944)

An experimental investigation was conducted of the performance characteristics of the Bell IIIB accelerometer, and the characteristics were related to those of the mathematical model of the instrument. The investigation included an analysis of the instrument and derivation of its model, discussion of test instrumentation and instrument limitations, data collection and reduction techniques, and interpretation of the results of the experimental work. Data on the instrument taken prior to the aerospace tests are included. Correspondence of the test data was reasonably good. Initially, however, changes in accelerometer coefficient values occurred during the test period. Criteria for improved instrumentation and procedures were developed. Author

N64-26111 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SIX-COMPONENT WIND-TUNNEL BALANCE

N. P. Levitskiy 12 Jun. 1964 7 p Transl. into ENGLISH from Soviet Patent no. 152117, 12 Dec. 1961 p 1-4

(FTD-TT-64-46/1+2; AD-442481)

A six component wind-tunnel balance is described. The sensitive elements of the balance are made up of inductive converters that measure and counteract the distance of displacement of the model being measured. The converters are connected to a bridge circuit that compensates for moments not being measured. The elastic supports that support the converters are used to measure small aerodynamic forces and horizontal forces and moments. The vertical forces and moments are measured by membranes placed so that their axes coincide with the direction of the measured forces.

P.V.E.

N64-26189 ARO, Inc., Arnold Air Force Station, Tenn. Aerospace Environmental Facility

EVALUATION OF POROUS MATERIALS AS MOLECULAR LEAKS

A. J. Mathews Arnold Eng. Develop. Center, Jul. 1964 31 p refs

(Contract AF 40(600)-1000)

(AEDC-TDR-64-94)

Very small and accurately known gas flow rates, which may be varied continuously over several orders of magnitude, are often required in vacuum work. Commercial flowmeters can be used for the direct measurement of gas flow rates down to about 10^{-2} torr-liters/sec, but below this level calibrated leaks must be employed. This report presents and experimental evaluation of fritted glass, porous glass, porous bronze, and sintered stainless steel as molecular leaks to obtain continuously variable flow rates over the range from 10^{-1} to 10^{-7} torr-liters/sec. The evaluation is based on the adsorption properties of each type of leak, the pressure range over which each leak exhibits a constant conductance value, and the general utility of each type of leak. A method is presented whereby the conductance of a sintered stainless steel leak may be set to any specified value in the range from 3×10^{-3} to 1×10^{-5} liters/sec.

Author

N64-26191 Bell Helicopter Co., Fort Worth, Tex.

ALTIMETER DISPLAY STUDY: PART I. SUMMARY AND REVIEW OF DATA REQUIREMENTS Final Report, May 1960-Jan. 1963

W. G. Matheny Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., May 1964 86 p refs

(Contract AF 33(616)-8236)

(ASD-TDR-63-621, Pt. 1; AD-601834)

A number of reports dealing with flight control information requirements is presented. The distinction between system data requirements as the totality of data to be processed by the system, and information requirements as the totality of data to be processed by the human operator is discussed. Specifying total system data requirements must logically precede division of functions between man and machine and the dependent specifying of information requirements. Compromise and successive approximations to the ideal are fundamental to, and ever present in, the process of proceeding from mission objectives to display, control, and console specifications. Both functions and data handling requirements must be plotted against a time reference. The optimization of system performance may sometimes be brought nearer through a judicious mixture of selection and training of the operator and design and equipment development. It may, at times, prove more economical and efficient to trade sophistication in design and equipment development for more stringent selection and increased training. Author

N64-26192 Thiokol Chemical Corp., Brigham City, Utah Wasatch Div.

REINFORCED PLASTIC CONSTRUCTION METHODS FOR LARGE ROCKET MOTOR CASE. VOLUME I: PROGRAM SURVEY Final Technical Engineering Report, 5 Mar. 1961-15 Nov. 1963

W. G. Morse and F. W. Dallon Wright-Patterson AFB, Ohio, Mfg. Technol. Div., Dec. 1963 181 p

(Contract AF 33(600)-42511)

(TR-63-7-858, Vol. I; AD-262835)

The objective of the program was the deve opment of designs, fabrication processes, techniques, and equipment for manufacture of fiberglass plastic rocket motor cases. Case designs and manufacturing methods were established for both monolithic and modular construction of large (44- and 65-in.-diam) plastic cases. Design included derivation of dome contours, stress analysis of case assemblies and components, and specification of fiberglass, resin systems, case liners, hardware, and mandrels. Winding patterns and wrapping angles were evaluated using computer programs. Two cases of each design were fabricated, at least one of which was subjected to hydroburst testing. The TU-226A (Lamtex) 65-in.-diam case withstood design pressure (1,113 psig design; 1,164 burst). The TU-227A (Allison) and TU-227B (Brunswick) 44-in.-diam cases withstood design pressure (794 psig design; 1,185 and 1,188 psig burst) with high stress (300,000 psi). Failures due to causes other than case rupture (forward skirt failure; aft cover plate failure) prevented attainment of case rupture for cases fabricated by Black, Sivalls & Bryson (TU-226B 65-in.-diam) and Brunswick Corporation (TU-227B 44-in. diam). Hydroburst tests on small diameter (18-in. diam) TU-228 cases (1,113 psig design; 1,595 and 1,800 psig burst) proved the feasibility of modular construction of fiberglass cases. Although a large TU-228 case (65-in. diam) ruptured below the design proof value (890 psig design; 840 psig burst), failure was attributed to module misalignment rather than to design defect. The hydroburst test of TU-290 case No. 3 (379,000 psi hoop stress at 750 psig) successfully culminated progressive development of the TU-290 single nozzle case design. Author

N64-26259 Joint Publications Research Service, Washington, D.C.

ULTRASONIC AND ELECTRONIC MEDICAL DEVICES

B. I. Minchenkova et al 21 Jul. 1964 19 p refs Transl. into ENGLISH of three Articles from Med. Prom. (USSR), v. 18, no. 2, 1964 p 46–55
(JPRS-25533; TT-64-31805) OTS: $0.50

The following are described: (1) the URP-1P portable apparatus for ultrasonic therapy; (2) the UM2-2 type ultrasonic installation for the cleaning of medical instruments; and (3) the EVA-6-100m electrohygrometer for determination of skin moisture. R.T.K.

N64-26271 General Electric Co., Syracuse, N.Y.
LIGHTNING PHENOMENA INVESTIGATION Final Report
J. J. Klapper, A. F. Rohlfs, F. A. Ludewig, and F. A. Fisher
Kirtland AFB, N. Mex., AF Weapons Lab., Mar. 1964 84p
(Contract AF 29(601)-5402)
(WL-TDR-64-21; AD-440274)

The lightning-phenomena investigation program was designed to determine induced voltage and currents in certain selected missile-site cables as a result of a lightning discharge on or near the instrumented SM-78 site. The characteristics of the lightning discharge, which produced the induced signals, were measured; in addition, background meteorological measurements were made to facilitate the analysis of the storm event and the resulting data. Limited oscillographic surge data are presented on the only three storms that occurred in the vicinity of the instrumented site. Data are also presented on the 6-month continuous monitoring period on the meteorological parameters, point discharge current, and the atmospheric electric gradient. Author

N64-26306 Federal Aviation Agency, Atlantic City, N.J. Experimentation Div.
CALIBRATING STATIC PRESSURE SYSTEMS AT LOW ALTITUDES Final Report
Jack J. Shrager Mar. 1964 61 p
(RD-64-37)

A procedure for use in the determination of position error at low altitudes of aircraft airspeed systems and for the calibration of such systems is presented. The procedure describes a flight-test technique, reduction of the test results by use of nomograms, and a simplified statistical method for determining position error correction for different indicated airspeeds. Author

N64-26360* Pennsylvania State U., University Park Ionosphere Research Lab.
A HIGH FREQUENCY PHASE COMPARATOR FOR ROCKET INSTRUMENTATION Scientific Report No. 210(E)
J. P. Froehlich 10 Jun. 1964 72 p refs
(Grant NsG-134-61)
(NASA-CR-58057) OTS: $7.60 ph

An analysis of a high-frequency phase comparator using diode vector rectifiers is presented. The output voltage as a function of phase angle is determined. Errors arising from assuming a sinusoidal output are analyzed along with errors due to incorrect alignment of the phase splitting network used to obtain quadrature outputs. Effects of temperature on the components are investigated. Author

N64-26493 Naval Radiological Defense Lab., San Francisco, Calif.
AN AUTOMATED FAST COINCIDENCE NUCLEAR RADIATION SPECTROMETER
J. P. Hurley 6 Mar. 1964 42 p refs
(USNRDL-TR-729; AD-600143)

An essential experimental technique in a program of nuclear structure research is fast-coincidence nuclear radiation spectroscopy. A logical consequence, then, of a decision to increase the emphasis on nuclear structure research was to undertake the design and construction of the subject spectrometer. Combining the very latest and best commercial electronic units with techniques and components developed and constructed in the laboratory has resulted in an instrument that can be regarded as a state of the art in nuclear structure research. Two important requirements most influenced the design of the spectrometer. The one was the need for very short coincidence resolving times together with a slow linear signal from each detector, and the other was the convenience of automatic continuous operation. The extensive design studies and experimentation needed to satisfy both requirements are described in the report. In addition, because of the possible applications to similar spectrometers and because it serves to acquaint potential users of the subject instrument with the automatic operation, the automation system is described in detail. Author

N64-26507 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
IMPROVEMENT OF SENSOR RESPONSE BY AN ANALOG TECHNIQUE
Heinz H. Grote Mar. 1964 17 p
(USAELRDL-2445; AD-600141)

A sensor is defined, and it is shown that sensors can frequently be described by linear differential equations. This allows a simple restoration of the input from the measured output. As an example, a thermocouple–thermometer is investigated. Results and limitations of the presented restoration technique are treated. Author

N64-26520 European Organization for Nuclear Research, Geneva (Switzerland) NPA Div.
A PHOTO SCANNING AND MEASURING DEVICE
G. Kuhn 5 Jun. 1964 37 p
(CERN-64-28)

The photoscanner has been specifically designed for measuring the X and Y coordinates of nuclear tracks on bubble-chamber photographs, and converting this information into digital form on a standard five-hole tape. An electric typewriter is provided to punch additional information in order that the coordinates may be identified, and to make the output suitable for direct input to a digital computer. Descriptions, functional operation, and circuit diagrams are presented for the component units of the device. D.S.G.

N64-26585 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
THE REALIZATION OF ACTIVE SEISMIC SYSTEMS AND THEIR PRACTICAL APPLICATIONS
K. Ikrath and W. Schneider Apr. 1964 105 p refs
(USAELRDL-TR-2446; AD-601427)

Design and experimental performance data are given of portable tuned seismic transducers for the transmission and reception of seismic signals on the weathered layer of the earth. These transducers are the elastic analog of quarter-wave radio antennas. They are designed for operation with conventional loudspeaker or microphone amplifiers. Experimental models of these transducers for nominal 10-watt drive power at 80 ± 1.5 cps are the basic components in active seismic systems for communication, surveillance, and seismic exploration described here in detail. Seismic transmitters and receivers employing electrical- and seismic-feedback circuits are shown. Construction and operation of phased transducer-transmitter array circuits for the launching of directional seismic waves are described. Seismic signaling and measurement

methods employing CW and amplitude, frequency, and phase modulation are described. The results of various experiments with these systems on lake ice and on soil in partially wooded terrain are given in the form of experimental data on communication ranges, power levels, signal-propagation velocities, and signal attenuation in ice and in the weathered layer of the earth; relevant environmental factors are discussed, and their influence on the propagation characteristics of seismic signals are shown. Author

N64-26629* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
FLIGHT-INFORMATIONAL SENSORS, DISPLAY, AND SPACE CONTROL OF THE X-15 AIRPLANE FOR ATMOSPHERIC AND NEAR-SPACE FLIGHT MISSIONS
Jack Fischel and Lannie D. Webb Washington, NASA, Aug. 1964 34 p Presented at the Aviation and Space Travel Congr. on Interrelations between Air and Space Navigation and Aerospace, W. Berlin, 22–27 Apr. 1963
(NASA-TN-D-2407) OTS: $1.00

Various flight-informational sensors and some nonconventional pilot-display quantities were evaluated and used on the X-15 airplane during the expansion of the flight envelope to high altitudes and hypersonic speeds, and in the accomplishment of the programed research missions. Also, flight-guidance information was provided by the ground-control monitoring stations. Several of the systems evaluated appear to be satisfactory for providing research and pilot-display information relative to airspeed, altitude, dynamic pressure, flow-direction angles, and vehicle attitude. Other systems need additional refinement of calibration and some onboard computational equipment if required for the pilot display. Author

N64-26640 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
MEASUREMENT OF NEUTRON TISSUE DOSE BEHIND REACTOR SHIELDING
I. B. Keyrim-Markus, J. T. Korneyev, V. V. Markelov, and L. N. Uspenskiy 31 Mar. 1964 17 p refs Transl. into ENGLISH from Izmereniye Tkanevykh Doz Neytronov za Zashitov Reaktora Sympozium po Biologicheskomy Vozdeystviyu Neytronnykh Oblucheniy (USSR), 7–11 Oct. 1963 p 1–16
(FTD-TT-63-1047/1+4; AD-600135)

A rapid method for analyzing the tissue dose composition of neutron radiation behind reactor shielding is described. The flux density of the thermal neutrons was measured with detector *T* without the cadmium filter. Possible variations in neutron temperatures were neglected in the measurements. The tissue dose rate of thermal neutrons was determined from the ratio of 1,100 neutron/cm^2 sec ~1 μrem/sec. The tissue rate of the intermediate and fast neutrons was measured by detector *T* with a cadmium shield. The flux density and tissue dose rate of intermediate and fast neutrons were also measured with a scintillation counter plus a cadmium-covered polyethylene sphere, 210 mm in diameter, and with a scintillation counter plus a drop-shaped paraffin body with a 250-mm diameter. Inside of this body was concentrically arranged spherical coating of paraffin-filled cadmium, 150 mm in diameter. I.v.L.

N64-26658 Virginia U., Charlottesville Research Labs. for the Engineering Sciences
COMPARATIVE STRESS ANALYSIS FOR LARGE DYNAMIC ACCELERATORS. PHASE I: FEASIBILITY STUDIES OF A FLYWHEEL ACCELERATOR Summary Engineering Report
D. L. Bowers, J. A. Friedericy, C. N. Gaylord, and S. E. Thornton Nov. 1962 111 p refs
(Contract AF 29(600)-3465)
(CE-4462-106-62U; AD-437565)

The purpose of this study was to establish the feasibility of a flywheel accelerator for testing man–machine systems under conditions of space flight. This flywheel must be capable of accelerating a 232,500-lb test package to 300g in 5 sec. The flywheel configuration that is recommended is 145-ft diam, has 22 linearly tapered box spokes, and has a subdivided box rim, 12.58 sq ft in cross section. This wheel weighs 5×10^6 lb and can be constructed from commercial steels. The static analysis of stresses and displacements of a flywheel were solved and some of the problems connected with latching-on a capsule were studied. Also, such areas as power requirements, bearings, and capsule support were discussed. Author

N64-26672 Electronic Associates, Inc., Long Branch, N.J.
PHOTOGRAMMETRIC PLOTTER MODEL AS-9 (XW-1) Final Report
Edward J. Paschetto and Joseph A. Fornataro Jun. 1963 61 p
(Contract AF 30(602)-2581)
(RADC-TDR-63-367; AD-437801)

The mathematical analysis, engineering design, operating procedures, and error evaluation of the Model AS-9 (XW-1) photogrammetric plotter are discussed. This equipment will rectify the geometric distortion in oblique and panoramic photography. The information to be rectified is manually traced and is then automatically plotted orthographically in ink or pencil. Author

N64-26744 Sandia Corp., Albuquerque, N. Mex. Sandia Lab.
AN ERROR ANALYSIS OF A TWO-COMPONENT STRAIN-GAGE BALANCE
J. K. Cole Jul. 1964 19 p
(SC-RR-64-698)

An error analysis was made of a simple, two-component, strain-gage balance. This type of strain-gage balance is commonly used to determine the normal force and center of pressure of a model being tested in a wind tunnel. The analysis establishes the explicit relations between the errors in the calculated normal force magnitude and the center of pressure as functions of the errors in the calibration constants and the actual center-of-pressure location relative to the balance. The results indicate that very large errors in the calculated normal force and center of pressure may occur when the actual center of pressure is not located between the strain-gage stations. Graphs are presented that show the magnitude of these errors as a function of the center-of-pressure location for ± 1% errors in the balance calibration constants. Author

N64-26805* Chicago U., Ill.
SILICON PHOTODIODE VACUUM ULTRAVIOLET DETECTOR
A. J. Tuzzolino [1964] 18 p refs Submitted for Publication (Grant NsG-179-61)
(NASA-CR-580555) OTS: $1.60 ph

The photosensitivity of silicon surface barrier photodiodes was measured over the photon energy range from 4.9 to 21.2 ev (2,537 to 584 A). The photodiodes are operated in the reverse-bias mode at room temperature. The sensitivity of a typical photodiode with approximately 100 A of gold on the sensitive surface is 0.16 electrons/photon at 2,536 A and 1.1 electrons/photon at 584 A. The photosensitivity is uniform over the sensitive area (0.56 to 2.75 cm^2) to within a few percent. The operating characteristics of these devices are reported, and the

use of the silicon photodiode directly, or in combination with sodium salicylate, as a vacuum ultraviolet detector is discussed. Author

N64-26816 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
AFA-TEU AIRCRAFT CAMERA AND ITS TESTS
V.B. il'in and V.D. Derviz 10 Jun. 1964 21 p refs Transl. into ENGLISH from Tsentr. Nauchn.-Issled. Inst. Geod. (Moscow), no. 146, 1962 p 3-15
(FTD-MT-63-353; AD-409948)

The AFA-TEU aerial camera is described. The improvements found in this camera include a high-speed ZBS-M shutter with an automatic device for adjusting the time of exposure; a cassette that stabilizes the tension of aerofilm during its straightening and exposure; and electromagnetic friction clutch with a variable moment; and a system of straightening the film, based on its stabilization tension and the action of a vacuum. Results of tests show that this camera possesses the following special features: (1) It allows aerial photographic survey on all scales required for constructing topographic maps. (2) It permits the use of highly sensitive as well as colored and spectrozonal photomaterials in aerial surveys. (3) It permits the obtainment of aerial negatives with practically constant integral density and increased quality, as well as the automation of their laboratory processing. (4) It insures higher quality of strengthening of aerofilm in a plane. (5) It increases the accuracy of the measurement of a systematic part of the aerofilm deformation that is caused by its tension in the cassette. I.v.L.

N64-26841 General Electric Co., Cincinnati, Ohio Nuclear Materials and Propulsion Operation
HIGH-TEMPERATURE EXTENSION OF CONVENTIONAL NUCLEAR SENSORS Final Report
R. L. Treinen 10 Aug. 1964 32 p
(Contract AT(40-1)-2847)
(GEMP-298) OTS: $0.75

This report describes the results of the development for extending the operating temperature capability for fission counters to a temperature of 816° C and d.c. ionization chambers to a temperature of 538° C. Fission counter operation to a temperature of 816° C is feasible and component construction provides an adequate margin of over-temperature safety. Direct current ionization operation at a temperature of 538° C is possible using presently available materials. Reactor power range neutron sensing with d.c. ionization chambers can probably be extended to a temperature of 649° C. A major portion of the testing phase of the program was devoted to the evaluation of metal-to-ceramic vacuum seals. The results of testing indicate that vacuum seals are now available that possess outstanding characteristics of reliability, ruggedness, and long-life at the appropriate temperature. The design and testing results for compatible sensor lead extensions are also described. Author

N64-26859 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
A METHOD FOR PROBE STUDIES OF A D-C CORONA FIELD USING AN OSCILLOGRAPH
V. I. Levitor, A. G. Lyapin, V. I. Popkov, and Ch'ing Ch'ien-Yang 3 Jan. 1963 17 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Energ. i Avtom. (Moscow), no. 2, 1962 p 47-54
(FTD-TT-62-1530/1+2+4; AD-295785)

Presented is a probe method for studying the field of a d.c. corona discharge, using an oscillograph. In this study, the characteristics of the electrical components and the outside disturbances, effect on the measurements of the oscillograph are paramount. The method makes possible the determination of the capacitance of the probe by measuring from oscillograms the amplitudes of the probe current and the alternating component of the probe voltage. In addition, the rate of change of the voltage must be known. A schematic drawing of the apparatus with its circuit components, and equations that explain the ratio of amplitude of the ion current to the amplitude of the displacement current are given. A.L.B.

N64-26899 Bell Helicopter Co., Fort Worth, Tex.
ALTIMETER DISPLAY STUDY. PART II: HANDBOOK FOR STATIC TESTING OF ALTIMETERS Final Report, May 1960-Jan. 1962
C. B. Elam, W. G. Matheny, and D. A. Schum Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., May 1964 151 p refs
(Contract AF 33(616)-8236)
(ASD-TDR-63-622, Pt II; AD-601835)

Studies conducted of altimeter display designs evaluation are presented to evaluate the validity and reliability of various evaluation techniques (static, flight simulator, and in-flight test). The study begins with the static open-loop display design. For each of the three altimeter display designs, static statistical measurements are presented along with an apparatus drawing and background information. A.L.B.

N64-26901 Federal Aviation Agency, Atlantic City, N.J. Evaluation Div.
EVALUATION OF GENERAL AVIATION TRANSPONDERS Final Report
Robert W. Delaney Jun. 1964 61 p refs
(RD-64-90)

Operational performance tests were conducted with transponders. Four each of the prototype transponders were furnished and installed by FAA for operation in various aircraft. Questionnaires completed by the pilots of these aircraft provided data for estimating the performance and utility of the transponders along with benefits that might be derived from widespread implementation. It was concluded that while both types of transponders met the contract specifications, design changes are required to correct performance deterioration during operational use. It was also concluded that acceptance and utilization of the transponders depend upon the extent to which its purchase price can be reduced and the equipment operational life increased. Author

N64-26914 Naval Research Lab., Washington, D.C. Metallurgy Div.
BRIGHTNESS AND TWO-COLOR PYROMENTARY APPLIED TO THE ELECTRON BEAM FURNACE
H. Doering and P. Shahinian 10 Jun. 1964 16 p
(NRL-6062; AD-602292)

A procedure for temperature measurement and control in an electron beam furnace was established by using the optical and two-color pyrometers. The emissivity of the specimen and attenuation by the furnace sight-port glass and metallic vapor coatings introduced errors in the readings made by both instruments. These errors in two-color readings were considerably less than those in readings made with the optical pyrometer. To permit the determination of the true temperature of a test specimen, an empirical correlation was made between the temperature of a blackbody hole and the brightness of a surface simulating that of a test specimen. The accuracy of this correlation is discussed with respect to the quality of the blackbody holes, the errors in sight-port glass corrections, instrument calibration, and the accumulated statistical uncertainties of pyrometer readings. Author

N64-26923 Johns Hopkins U., Baltimore, Md. Lab. of Astrophysics and Physical Meteorology
VACUUM ULTRAVIOLET GRATINGS Final Report
Murk Bottema and John Strong 30 Apr. 1964 13 p
(Contract AF 19(604)-6139)
(AFCRL-64-398; AD-602752)

The efforts to produce efficient diffraction gratings for the vacuum ultraviolet are reviewed, and data on 40 gratings ruled for the sponsor are given. The efforts included studies of diamond wear, and experiences on ruling bare glass — aluminum, platinum, and coated films deposited on glass — and on both bare and coated glass rulings subsequently etched. Some of the ruling results were photographed with an electron microscope. Author

N64-26927 Sandia Corp., Albuquerque, N. Mex. Sandia Lab.
PHANTOM GAGE DIMENSIONING (COMBINED PART/GAGE SPECIFICATIONS)
E. S. Roth Jul. 1964 15 p
(SC-TM-64-669) OTS: $0.50

This memorandum discusses a new design definition technique, requiring no standard, which pictorially shows part and gage limits on the same drawing. When functional gages, test fixtures, or optical chart gages are the selected inspection method, design, manufacturing process, and gage engineers can use these drawings directly to replace the usual standards-based drawings. In essence, this advanced technology visually describes true position dimensioning and tolerancing. It enables product designers to directly control the acceptance process. Author

N64-26936 Aeronutronic, Newport Beach, Calif.
DYNAMIC LARGE SCREEN ELECTROCHEMICAL DISPLAY Final Report
G. Galli, W. D. Gerber, and M. H. White Griffiss AFB, N.Y RADC, Jun. 1964 96 p refs
(Contract AF 30(602)-3010)
(RADC-TDR-64-137; AD-602826)

The basic technique employs photoconductor phenomena in conjunction with electrochemical deposition action. A light image from a cathode ray tube or other source is directed on a photoconductor layer at the rear of a reversible electrochemical layer. The changes in conductivity in the photoconductor layer provide the means for exceeding the deposition potential of the affected parts of the electrochemical layer, thus producing the original light image in the form of electrochemical deposits. The result is a display viewed in reflected ambient light. Author

16 LIFE SCIENCES

Includes biology; exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness. *For related information see*: 14 Human Behavior; and 28 Space Radiation.

N64-25842 Flying Personnel Research Committee (Gt. Brit.)
VISUAL PERCEPTION OF MOVEMENT
T. C. D. Whiteside (Inst. of Aviation Med., RAF) Air Ministry, 23 Aug. 1963 16 p refs An Edridge Green Lecture Presented at the Roy. Coll. of Surgeons of Engl. See A64-80214
(FPRC/MEMO-191)

Human visual behavior is discussed generally, with special attention given to motion perception. It is suggested that the conclusions could be applied in the use of a stable observer's platform for the airborne avoidance of collisions, and to the design of space-vehicle rendezvous systems. D.E.W.

N64-25843 Flying Personnel Research Committee (Gt. Brit.)
A METHOD OF DETERMINING TRANSMISSION LOSSES IN A BICYCLE ERGOMETER
D. Denison and A. Jarrett (Inst. of Aviation Med., RAF) Air Ministry, Jun. 1963 5 p
(FPRC/MEMO-198)

A description is given of a method of determining transmission losses in a bicycle ergometer. The method is based on the physical principle that the work required to halt a moving body equals the kinetic energy of the body. For the rotating flywheel of a bicycle ergometer, the work of halting the wheel is equal to the kinetic energy of the wheel. The results obtained suggest that the method is satisfactory and simple. A value of transmission resistance representing about 10% of a light workload, and a variation in resistance with flywheel velocity that is equivalent to about 2% of a light workload are obtained. The practical conclusion is that 0.1 kg wt can be added to the observed brake-band tension in calculating the work done with the effect of velocity being ignored. I.v.L.

N64-25844 Flying Personnel Research Committee (Gt. Brit.)
CLOTHING FOR PROTECTION AGAINST COLD IN FLIGHT. II: A TRIAL OF ELECTRICALLY HEATED UNDERWEAR BY NAVIGATORS OF 85 SQUADRON, R.A.F. WEST RAYNHAM
J. D. Nelms (Inst. of Aviation Med., RAF) Air Ministry, May 1963 25 p refs
(FPRC/MEMO-200)

Electrically heated underwear, gloves, and socks were worn by 32 navigators for about 200 hours in Canberra T.11 and T.4 aircraft engaged in high-altitude winter flights. In all cases sufficient warmth was available, and a great increase in comfort was reported. Further modifications are needed to the gloves and main lead, and a compact voltage controller is required. The suit should be integrated with the immersion suit for maximum benefit. Author

N64-25845 Flying Personnel Research Committee (Gt. Brit.)
ASSESSMENT OF INTERIM SEAT MOUNTED OXYGEN SYSTEM FOR LIGHTNING MK. V (OP.7190)
P. R. Wagner (Inst. of Aviation Med., RAF) Air Ministry, Jul. 1963 23 p refs
(FPRC/MEMO-202)

The oxygen system described consists of two separate seat-mounted demand systems, the outlets of which are fed into a common line immediately upstream of the personal equipment connector. The main regulator operates from the aircraft liquid oxygen system; the emergency or standby regulator operates from the emergency oxygen cylinder. The sample system is within the standards required except for the air mix characteristics. R.T.K.

N64-25846 Flying Personnel Research Committee (Gt. Brit.)
THE ELEVATOR ILLUSION
J. I. Niven, T. C. D. Whiteside (Inst. of Aviation Med., RAF), and A. Graybiel (Naval School of Aviation Med.) Air Ministry, Oct. 1963 17 p refs
(FPRC/1213)

Two normal and two labyrinthine defective subjectives were exposed to vertical accelerations of either less than 1 g or more than 1 g on descent or ascent, respectively, in an elevator. Three targets were utilized: a real target alone, a visual afterimage alone, and a combination of both. In general, it was found that normal subjects tend to perceive illusory movement of real targets and visual afterimages during vertical acceleration greater and less than 1 g. Real target apparent movement is downward when $g < 1$ and upward when $g > 1$; for a visual afterimage the directional relationships are reversed. There is no well-defined Displacement of a real target whereas marked displacement occurs with a visual afterimage. When viewed in combination, the same relationships are maintained. For subjects lacking vestibular function, there is no apparent movement of real targets at any time. Further experiments carried out on three normal subjects and one bilateral labyrinthine defective revealed that, in the change from 1 g to zero g, there is an involuntary upward eye movement in normals that lasts at least 150 msec. The failure to demonstrate this in the labyrinthine defective subject suggests, therefore, that the change is reflex and probably otolithic in origin. Author

N64-25847 Flying Personnel Research Committee (Gt. Brit.)
VISUAL ILLUSIONS OF MOVEMENT
T. C. D. Whiteside (Inst. of Aviation Med., RAF) A. Graybiel, and J. I. Niven (Naval School of Aviation Med.) Air Ministry, Jun. 1963 20 p refs
(FPRC/1207)

Visual illusions are related to involuntary eye movements, occurring either spontaneously as in the autokinetic illusion, or in response to the special stimuli associated with the other two illusions. During fixation, the visual sensation of movement seems to be produced by, or related to, the pattern of efferent activity aimed at the group of extraocular muscles that will act as antagonists to the involuntary eye movement referred to. Under certain circumstances, when the stimulus change is rapid, an eye movement may be detected before the fixation reflex has time to operate. Since the sensation can be caused by the pattern of antagonist efferent activity, it can arise during fixation with no demonstrable responsible eye movement. The displacements of a visual afterimage as a result of the involuntary eye movements, are predominantly in the direction of agonist activity. Author

N64-25848 Flying Personnel Research Committee (Gt. Brit.)
THE IDEAL RELATIONSHIP BETWEEN INSPIRED OXYGEN CONCENTRATION AND CABIN ALTITUDE
J. Ernsting (Inst. of Aviation Med., RAF) Air Ministry, Apr. 1963 16 p refs Presented at the 34th Ann. Meeting of the Aerospace Med. Assoc.
(FPRC-1214)

The factors that determine the physiologically desirable relationship between the concentration of oxygen in the inspired gas and the absolute pressure within a pressure or sealed cabin were reviewed. The minimum acceptable concentration of oxygen at a given cabin altitude is determined by the need to prevent hypoxia both in the steady state and following a sudden decompression. The maximum allowable concentration of oxygen is influenced principally by the direct toxic effects of oxygen upon the respiratory tract, and by the need to reduce the possibility of gross pulmonary atelectasis in the presence of blockage of the airways induced by exposure to accelerative forces. The incidence of decompression sickness is the main factor that limits the maximum cabin altitude, and it can also influence the composition of the gas breathed in the intact cabin if depressurization of the cabin or the use of a full pressure suit have to be considered. Although in certain areas there is conflict between these various requirements the physiological ideal at cabin altitudes below 20,000 ft is an inspired oxygen concentration of 50%. Author

N64-25880* Brandeis U., Waltham, Mass.
SPECIFICITY OF THE COMPLEMENTARY RNA FORMED BY *BACILLUS SUBTILIS* INFECTED WITH BACTERIOPHAGE SP8
J. Marmur, C. M. Greenspan, E. Palecek, F. M. Kahan, J. Levine et al Repr. from Cold Spring Harbor Symp. on Quant. Biol., v. 28, 1963 p 191–199 refs
(Grant NsG-375)

Some of the properties of SP8 DNA and the consequences of infection upon host biosynthesis are presented. Also presented is a discussion of a study of DNA–RNA hybridization. The DNA of bacteriophage SP8 (whose host is *Bacillus subtilis*) when denatured yielded two components of differing buoyant density in cesium chloride density gradients. The denser of the two strands, the H strand, contained more pyrimidines and fewer purines than the lighter L strand. Only the H strand formed hybrids with a pulse-labeled RNA synthesized by the infected host. The L strand is capable of annealing with complementary RNA synthesized *in vitro* and works as a primer in reactions catalyzed by RNA polymerase. During the vegetative development of phage, host cells synthesize RNA at normal rates. A small fraction of this RNA forms hybrids with denatured bacterial DNA. Bacteriophage DNA was found not to hybridize with host DNA (in agar-gel columns), which is taken to indicate that the RNA–DNA complexes reflect host messenger synthesis. It is concluded that only one of the two complementary strands of bacteriophage SP8 DNA acts as a template for the synthesis of phage specific RNA *in vivo*. P.V.E.

N64-25892 Geoscience Ltd., La Jolla, Calif.
THERMAL AND ELECTRICAL CONDUCTIVITIES OF BIOLOGICAL FLUIDS AND TISSUES Annual Report, Apr. 1, 1963–Mar. 31, 1964
H. F. Poppendiek, N. D. Greene, V. H. Breeden, J. R. Murphy, and P. M. Morehouse [1964] 38 p refs
(Contract Nonr-4095(00))
(GLR-20; AD-438144)

This report describes research on thermal and electrical conductivities of biological fluids and tissues. A literature search on thermal and electrical conductivity of biological materials was conducted. Analytical studies were initiated that will make it possible to estimate or establish the controlling variables of thermal and electrical conductivities of biological fluids and tissues. The results are for correlating more effectively the experimental measurements obtained. Author

N64-25906* Aeronutronic, Newport Beach, Calif. Research Labs.
STUDY OF THE FUNDAMENTAL PRINCIPLES OF BIOELECTROCHEMISTRY Final Technical Report, Mar. 1963–Mar. 1964
R. C. Bean, Y. H. Inami, P. R. Basford, M. H. Boyer, W. C. Shepherd et al 30 Jun. 1964 111 p refs
(Contract NASw-655)
(NASA-CR-54051; U-2670) OTS: $9.60

Reactions of biological systems at an electrode were investigated experimentally and through theoretical considerations to determine the capability of biochemical reactions in producing useful electrochemical energy. Experimental work with microorganisms and several enzymes established that electrochemical energy may be derived either through formation of enzymatic conversion of electrochemically inactive fuels to active products or from electron exchange between the electrode and the enzyme via an electron carrier intermediary molecule. However, no evidence was obtained for a significant electron transfer directly from enzymes to the electrode. Were such a reaction to exist, theoretical calculations for a model system suggest that the maximum current through the direct reaction would be very small in relation to the output possible from the other types of reactions. There is need for extreme care in defining the actual reactive electrochemical systems in the biofuel cells since extraneous materials in the biological systems may be responsible for relatively large, temporary electrical outputs.
Author

N64-25925 Linde Co., Tonawanda, N.Y. Research Labs.
THE PHYSIOLOGICAL EFFECTS OF ARGON, HELIUM, AND THE RARE GASES
H. R. Schreiner 30 Apr. 1964 104 p refs
(Contract Nonr-4115(00))
(AD-600641)

Basic studies in inert gas physiology were conducted. The investigations were primarily concerned with the elucidation of effects of the metabolically inert gases helium, neon, argon, krypton, xenon, and of nitrogen on cellular systems, on the neuromuscular complex, and on intact animals. Observation of the protoplasmic streaming activity of hyphal cells of the fungus *Neurospora crassa* demonstrated the specific and reversible inhibition of this cellular process by krypton and xenon. Experiments conducted with helium and nitrogen at pressures ranging up to 1,775 psia indicate that the growth retardation of *Neurospora crassa* by krypton and xenon cannot be related to a critical intracellular concentration of metabolically inert gases. The responses of the frog sciatic nerve–gastrocnemius muscle complex to compressed inert gases were studied. Experimentation with instrumented unanesthetized rats did not reveal electroencephalographic evidence of inert-gas anesthesia when the animals were exposed to 206 to 220 psia neon, argon, or nitrogen in the presence of 14.7 psia oxygen. In general, it is concluded that metabolically inert gases have the ability to intereact with a wide variety of biological systems on levels that range from subcellular to that of the intact higher animal.
P.V.E.

N64-25948* National Aeronautics and Space Administration, Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY · Continuing Bibliography, 1 Jan.–31 Mar. 1964
Jul. 1964 293 p refs
(NASA-SP-7011) OTS: $2.00

Aerospace Medicine and Biology, a monthly publication, is an annotated bibliography concentrating on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order will also be included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors will receive attention. In general, emphasis will be placed on applied research, but references to fundamental studies and theoretical principles related to experimental development also qualify for inclusion.
I.v.L.

N64-25951 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
AN ANALYSIS OF CONDITIONED REFLEXES AND OF THE THOUGHT PROCESSES OF THE HUMAN BRAIN
A. V. Napalkov and N. I. Bobneva 26 Mar. 1964 31 p refs Transl. into ENGLISH from Vopr. Psikhologii (Moscow), no. 6, 1962 p 40–54
(FTD-TT-64-184/1+4; AD-600585)

The development of a pattern of conditioned reflex chains in humans is described. The reflex chains were attained through a series of exploratory experiments. A pattern of reflex chains was formulated, and rules for working out the principles of information systems within the brain were determined. These rules determine the appearance, at a given moment in time, of random trial movements. In other states of the development of conditioning, random movements disappear and completely predictable movements appear. It was possible to establish several rules of choosing and processing information. It was found that the conditioning signals are significant as reinforcing stimuli that enter into an already developed chain of reflexes. For this, however, reinforcement must occur twice (double reinforcement).
R.T.K.

N64-25970* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
CHEMICAL EVOLUTION AND THE ORIGIN OF LIFE
Cyril Ponnamperuma Repr. from Nature, v. 201, no. 4917, 25 Jan. 1964 p 337–340 refs Previously Published as NASA-TM-X-54008; see N64-22754 16-16
(NASA-RP-233; NASA-TM-X-54008)

This is a contemplative, nontechnical review of the origin of life as viewed by scholars and philosophers of the past. Modern chemical knowledge is related to early cosmogenic hypotheses.
G.D.B.

N64-25975* National Aeronautics and Space Administration, Washington, D.C.
CONTROL OF BEHAVIOR BY DRUG-PRODUCED INTERNAL STIMULI
Richard E. Belleville Repr. from Psychopharmacologia, (Berlin), v. 5, 1964 p 95–105 refs
(NASA-RP-262)

Groups of rats were trained on a lever-pressing response under morphine, D-amphetamine, and placebo conditions. To assess the effects of changing internal stimuli, comparisons were made between groups extinguished under the same drug conditions, with those extinguished under different drug conditions. A greater number of extinction responses were made by those groups that received the same drug during both procedures. In a second extinction session, all animals received the same drug as that given during acquisition. A greater number of responses were emitted by those groups that were previously exposed to extinction under a drug condition different from that under which the response was acquired. The use of drugs for manipulating internal states is discussed.
G.D.B.

N64-26043 California U., Davis School of Veterinary Medicine
THE EFFECTS OF CONTINUED Sr^{90} AND Ra^{226} ON THE BEAGLE 7th Annual Progress Report

A. C. Andersen Jul. 1964 170 p refs
(Contract AT(04-3)-472)
(UCD-472-110)

Maintenance of a Beagle breeding colony has required routinely culling stock for reasons of age, poor conformation, and inability to breed. Observations have shown 147 separate clinical conditions in a 1-year period (average weekly population—approximately 285 dogs). Treatment of these conditions was routine. Experimental dog production has greatly increased, and there are at present 193 animals representing 16 different levels of either Sr^{90} ingestion, Sr^{90} injection, Ra^{226} injection or controls. Clinical conditions observed in this group totalled 113 (201 dogs). Facilities are functioning effectively. Author

N64-26055 Joint Publications Research Service, Washington, D.C.
THE STATE OF HEMOPOIETIC TISSUE IN ACUTE RADIATION SICKNESS UNDER CONDITIONS OF BONE MARROW TRANSPLANTATION
N. S. Rozanova, V. N. Malanina, G. V. Sukyasyan, and M. N. Novikova 26 Jun. 1964 16 p refs Transl. into ENGLISH form Arkhiv Patologii (Moscow), v. XXVI. no. 4, 1964 p 32–40
(JPRS-25251; TT-64-31556) OTS: $0.50

This is a study of the character of changes in the hemopoietic tissue of animals with acute radiation sickness treated by the administration of bone marrow. Pathologo-anatomical examination of 29 dogs after irradiation was made. The intravenous or intraosseous administration of bone marrow did not prevent the development of acute radiation sickness in animals irradiated with a minimal lethal dose (LD_{95}). G.D.B.

N64-26056 Joint Publications Research Service, Washington, D.C.
CURRENT DATA ON THE STRUCTURE, PROPERTIES AND PATHOLOGICAL CHANGES OF ELASTIC STRUCTURES
L. D. Zherebtsov 26 Jun. 1964 24 p refs Transl. into ENGLISH from Arkhiv Patologii (Moscow), v. XXVI. no. 4, 1964 p 3–17
(JPRS-25252; TT-64-31557) OTS: $0.75

This is a survey of the great advances made in recent years in the study of fibrous components of connective tissue, including elastic structures and the nature of the changes taking place in elastic in the course of various physiological and pathological processes. The chemical composition of elastic structures is described. Elastase and elastolysis are discussed. The ultrastructure of elastic fibers is considered. Systematic pathological changes in elastic structures are examined. G.D.B.

N64-26086 Joint Publications Research Service, Washington, D.C.
ULTRASONIC VIBRATIONS IN MOLECULAR BIOPHYSICS
I. Ye. El'piner 30 Jul. 1964 36 p refs Transl. into ENGLISH from Uspekhi Sovrem. Biol. (Moscow), v. 57, no. 2, 1964 p 211–231
(JPRS-25651; TT-64-31923) OTS: $2.00

Experimental material obtained in studying the biological action of ultrasonic waves is systematized and generalized. The accumulated experimental material is divided into four divisions: (1) use of ultrasonic waves in the synthesis of biologically important products—micromolecular and macromolecular compounds; (2) study of the action of ultrasonic waves on the structure of biomolecules and biomacromolecules in an attempt to establish the bonds between the structure and function of these substances; (3) use of ultrasonic waves to determine the topography of biocatalytical processes in animal, plant, and bacterial cells; and (4) study of the influence of ultrasonic waves on the space location of membrane and intracellular submicroscopic structures. P.V.E.

N64-26092 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE AURICULAR ELECTROKYMOGRAM
G. Bohenszky, Z. Bokor and E. Rozsa 3 Jun. 1964 13 p refs Transl. into ENGLISH from Orvosi Hetilap (Hungary), v. 104, no. 21, 21 May 1963 p 981–984
(FTD-TT-64-271/1+2+3+4; AD-442432)

Normal atrial electrokymograms and the diagnostic significance of pathological curves observed in the most frequently occurring vitia are discussed. It is concluded that examination of the atrial contour pulsations can yield delicate details of the atrial movements and also valid conclusions as to the hemodynamic conditions. P.V.E

N64-26113 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE EFFECT OF LIGHT ON GROWTH AND PHOTOSYNTHESIS OF CHLORELLA
A. M. Stepanova 12 May 1964 27 p refs Transl. into ENGLISH from Vestn. Leningr. Univ. (Leningrad), no. 21, 1963 p 72–78
(FTD-TT-64-246/1+2+4; AD-601552)

The form of the growth curve of algae that are supplied with all nutrient elements is closely connected to the dynamics of the photosynthetic rate. The latter, in turn, depends on light absorption by the culture and on the quantity of light striking each individual cell. The reactions of *Chlorella pyrenoidosa* and *Chlorella vulgaris* to a change in day length were identical. The largest increase in growth in both types and the smallest photosynthetic rate were observed during continuous illumination. As the dark period increased to 12 hours the photosynthetic rates increased, but further increase of the dark period (to 18 hours) did not noticeably affect the photosynthetic rate. J.L.D.

N64-26197 Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.
PHYSIOLOGICAL BASE-LINE STUDIES FOR CHIMPANZEES UNDER STABLE CONDITIONS OF FLIGHT
Thomas L. Gleason, III, and W. E. Ward (USAF Acad.) Mar. 1964 22 p refs
(ARL-TDR-64-4; AD-440106)

Physiological base lines for chimpanzees under stable conditions of flight were obtained. The characteristic of flight as well as physiological measurements made from flight to flight was statistically analyzed for 7 experienced animals and 7 naive animals. The more experienced subjects adapted more rapidly physiologically to aircraft flights. Both inter and intra animal analyses were performed. Heart rate, skin, and rectal temperature were slightly higher among the nonexperienced animals, while respiration rate was slightly higher in the experienced group. Author

N64-26212 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
AN ELECTROENCEPHALOSCOPE WITH DUAL COMMUTATION

V. M. Anan'yev 23 Mar. 1964 13 p refs Transl. into ENGLISH from Elektron. V Med. (Moscow), 1960 p 62–70
(FTD-TT-63-1190/1+2+4; AD-437117)

A system for visual display and photographic recording of as many as 50 signal channels from an electroencephalograph is described. A plan for sequential sampling and signal amplification is set forth, and multiplex circuits are shown schematically. D.E.W.

N64-26257 Joint Publications Research Service, Washington, D.C.
WHAT IS BIONICS?
P. T. Astashenkov 17 Jul. 1964 82 p refs Transl. into ENGLISH of the Book "Chto Takoye Bionika" Moscow, Mil. Publ. House of the Min. of Defense USSR, 1963 p 1–88
(JPRS-25494; TT-64-31766) OTS: $2.00

The following topics are included: (1) the origin and development of cybernetics; (2) sensory organs; (3) biocurrents and control at a distance; (4) location and navigation in nature and technology; (5) self-adjusting systems in biology and automatic devices; (6) electronic machines and the brain. R.T.K.

N64-26269 School of Aerospace Medicine, Brooks AFB, Tex.
OXYGEN AND THE EYE
Cecil C. Beehler Feb. 1964 23 p refs
(SAM-Review-3-64; AD-438909)

A summary is presented of literature dealing with the effects of high-oxygen environments on the visual mechanisms. Subjects covered by the summary concern ocular physiology, and the effect of oxygen on immature and mature retina. In general, it is indicated that oxygen is capable of producing severe systemic toxicity, and experimental studies in many animals have revealed a variety of pathologic changes, some of which resemble those found in retrolental fibroplasia. P.V.E.

N64-26348 Royal Canadian Air Force, Toronto Central Experimental and Proving Establishment
HIGH ALTITUDE MAN SEAT STABILIZATION STUDY
A. J. Campbell, comp. Jan. 1964 28 p refs
(CEPE-1681; AD-438523)

It was determined that man-stabilizing systems in existence may be useful. During the examination of the seat–man stabilizing proposal, it was discovered that, if high-energy rockets were to provide a reasonable escape envelope at low altitude and if the high-altitude drogues were to be deployed without tangling, a method of stabilizing the seat during rocket burning was required. Man–seat stabilization during descent could be provided by adding to the system a small drogue required during rocket burning. Man–seat stabilization was considered to be a more satisfactory method than man stabilization; therefore preliminary design of a system to stabilize CF104 seat was completed. It was recommended that the design developed herein be tested as a method of effectively using high-energy rockets at all altitudes. Author

N64-26351 Israel Program for Scientific Translations, Ltd., Jerusalem
BLOOD CIRCULATION IN THE BRAIN
B. N. Klosovskii [1963] 316 p refs Transl. into ENGLISH of the Book "Tsirkulyatsiya Krovi v Mozgu" Moscow, Medgiz, 1951
(OTS-63-11171) OTS: $3.25

Work on the problems concerning blood circulation in the brain involved investigations of collateral blood circulation in the brain, reflex influence of dura matter irritation on blood pressure and respiration, the innervation pial vessels of the brain, the reactions of pial and intracerebral vessels to nervous and humoral influences, the relationships between nerve cells and capillaries, and brain pulsations in open skulls and their absence in hermetically closed skull cavities. P.V.E.

N64-26357 Library of Congress, Washington, D.C. Aerospace Technology Div.
SPACE MEDICINE
V. V. Parin, ed. 15 Jul. 1964 71 p Transl. into ENGLISH from the book "Aviatsionnaya i Kosmicheskaya Meditsina: Materialy Konferentsii 1963 Goda" Moscow, 1963 *Its* ATD Press, v. 3, no. 10

This book consists of a collection of papers presented at a conference on aviation and space medicine held in 1963, under the joint sponsorship of the Academy of Medical Sciences U.S.S.R., the Pavlov All-Union Physiological Society, and the Moscow Physiological Society. The emphasis is on space medicine and subjects specifically germane to manned space flight, rather than on systems, hardware, and lower forms of life. The majority of these papers deal with effects of acceleration, weightlessness, and altered respiratory environments. Problems of sensory physiology and effects of isolation and hypodynamia are also covered. R.T.K.

N64-26372* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
EFFECTS OF STERILIZING AGENTS ON MICROORGANISMS Supplement to Literature Search No. 260
Janet Swift, comp. Mar. 1963 74 p refs
(Contract NAS7-100)
(NASA-CR-58123) OTS: $7.60 ph

A partially annotated bibliography of the following is presented: (1) physical agents—general radiation, gamma radiation, X-radiation, ultraviolet radiation, acoustics, and temperature variation; (2) chemical agents—ethylene oxide, β-propiolactone, ozone, propylene oxide, pesticides, and antibiotics; and (3) miscellaneous agents—general agents physical–chemical combinations. I.v.L.

N64-26459 Joint Publications Research Service, Washington, D.C.
PHYSIOLOGICAL ANALYSIS OF THE EFFECTS OF PRECEDING MUSCULAR EFFORTS ON THE WORKING CAPACITY OF UNFATIGUED MUSCLES
I. V. Muravov and F. T. Tkachov 27 Jul. 1964 13 p refs Transl. into ENGLISH of an article from Fiziol. Zhur., Akad. Nauk Ukr. RSR (Kiev), v. 10, no. 2, Mar.–Apr. 1964 p 163–170
(JPRS-25593; TT-64-31865) OTS: $1.00

A study was made of changes in the work capacity of flexor muscles of the right forearm under the effect of a different type of preliminary activity of symmetric muscles of the left arm. The study was conducted on young people (14 to 26) and aged persons (60 to 79); the method of ergography under conditions of repeated dynamic work was applied. A number of general regularities pertaining to the effect of preceding work of one muscle group on the work capacity of other groups was detected. The type of effect exerted by preceding effort on the work capacity of unfatigued muscles both in young and aged persons depends on the intensity of the preceding activity. Author

N64-26475 RAND Corp., Santa Monica, Calif.
ESTIMATION OF HEART PARAMETERS USING SKIN POTENTIAL MEASUREMENTS

R. Bellman, C. Collier, H. Kagiwada, R. Kalaba, and R. Selvester May 1964 17 p refs
(NIH GM-09608-02)
(RM-4138-NIH; AD-600754)

A mathematical model relating ventricular dipoles to surface potentials is sketched. The inverse problem—that of determining heart parameters on the basis of skin potential measurements—may be viewed as a nonlinear multipoint boundary value problem. Some numerical experiments show that quasilinearization provides a feasible method of solution. Author

N64-26499 Royal Inst. of Tech., Stockholm (Sweden) Speech Transmission Lab.
ACOUSTIC SPECIFICATION OF SPEECH Technical (Final) Report, STL Annual Report 1963
C. G. M. Fant 25 Jan. 1964 14 p refs
(Grant AF-EOAR-63-55)
(AFCRL-64-263; AD-600865)

The main body of this report contains summaries of 12 articles from the STL-QPSR of 1963. A main emphasis was laid on speech analysis techniques and the correlation of data from cineradiographic and spectrographic studies. These studies made it possible to present a simple mathematical model for describing formant frequency variations as a function of vowel duration and consonantal context. A special study emphasized the high degree of coarticulation between vowels and adjacent consonants and even one vowel across a consonant to the next vowel of the sequence. A considerable effort was laid on developing suitable routines for the cineradiography. A separate study was initiated with the scope of completing representative spectrographic material of Swedish and American-English speech. Other studies were concerned with the structure of the vocal source for voiced sounds by means of spectrum-matching techniques. Earlier theoretical studies of the mathematical and experimental procedure of defining formant amplitudes were followed. Author

N64-26550 Chicago Medical School, Ill. Div. of Cardiovascular Research
EFFECT OF OXYGEN INHALATION ON RESPONSES TO COLD EXPOSURE Annual Progress Report, Oct. 1, 1962–Sep. 20, 1963
D. M. Mac Canon [1963] 23 p refs
(Grant DA-MD-49-193-G43)
(AD-600077)

The experiments completed confirm the cold threshold raising effect of oxygen inhalation and emphasize the danger of relying solely on physical calculations of the intensity of a thermal stimulus. Indirect evidence that oxygen inhalation hinders carbon dioxide transport continues to accumulate. Instrumentation analyses suggest methods for improving polarographic measurements for pO_2 and for the infrared carbon dioxide analyzer. Author

N64-26609* Allied Research Associates, Inc., Concord, Mass.
A REVIEW OF BIOLOGICAL MECHANISMS FOR APPLICATION TO INSTRUMENT DESIGN
J. Healer, H. Homonoff, C. Jamieson, D. Kimura, S. Koslov et al Washington, NASA, Jul. 1964 316 p refs
(Contract NASw-535)
(NASA-CR-76) OTS: $5.00

This report summarizes the results to date of a review of biological mechanisms for application to instrument design and engineering performed for NASA. Principles of biosensor organization, structure, and function throughout the sensed parameters were investigated. The biosensors discussed were mechanoreceptors, photoreceptors, chemoreceptors, and thermoreceptors. The neural aspect of sensory functions and its application are discussed. I.v.L.

N64-26633 Institute of Cancer Research Royal Cancer Hospital, London (Gt. Brit.)
AN INVESTIGATION INTO THE MECHANISM OF ACTION OF RADIATION PROTECTIVE CHEMICALS Half Yearly Report, 1 Sep. 1963–1 Mar. 1964
P. Alexander [1964] 22 p
(Contract DA-91-591-EUC-3105)
(AD-439992)

There was considerable transfer of energy from the bovine serum albumin (BSA) to the DNA, when these two substances were dissolved, and the resultant solution was freeze dried. No indication of energy transfer was observed in a crude mixture wherein the two dry substances were just shaken together. A new effect of the SH compounds was observed in *E. coli* that did not involve a repair of radicals, but a change in their character. Some radicals were stable at room temperature, and some radicals disappeared on warming from −196° F to room temperature. Both the stable and unstable radicals showed similar repair action under the effect of cysteamine. In the presence of cysteamine, both types of radicals, formed in the bacterial cells, become peroxidized. These peroxy radicals were unstable. Iodoacetamide had a pronounced effect on the production of radicals in proteins and nucleoproteins. Targets other than DNA were considered. The fact that dose modification by SH compounds and iodoacetamide occurs when these substances cannot penetrate into the interior of bacterial cells suggests that important targets may be macromolecules near the plasma membrane of these cells. I.v.L.

N64-26653 Florida U., Gainesville College of Medicine
EFFECTS OF THE COMPRESSIBILITY OF ALVEOLAR GAS ON THE DYNAMICS AND WORK OF BREATHING
M. J. Jaeger and A. B. Otis Brooks AFB, Tex., School of Aerospace Med., Oct. 1963 19 p refs
(Contract AF 41(609)-1553)
(SAM-TDR-63-71; AD-437863)

Alveolar gas is compressed and expanded during every breathing cycle. The volume displacement measured at the mouth V_T (tidal volume) is therefore smaller than the volume displacement of the lung V_T that may be measured with a body plethysmograph. Experimental data found in normal subjects and in patients with obstructive emphysema confirm the theory that the ratio V_T/V_T decreases with increasing airway resistance, breathing frequency, and lung volume. There was little effect in normal subjects breathing at different breathing rates; however, in patients with obstructive emphysema it may be appreciable. With increasing altitude the effect is expected to be more pronounced. The mechanical work performed in compressing and expanding alveolar gas may be determined by recording the volume displacement of the lung simultaneously with tidal volume and intraesophageal pressure. Normally, work related to compressibility is insignificant, but in patients with obstructive emphysema, it becomes appreciable during hyperpnea. The compressibility of alveolar gas also increased the negative work performed by respiratory muscles. Author

N64-26665 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Bad Godesberg (W. Germany) Inst. für Flugmedizin
THE SIGNIFICANCE OF DECOMPRESSION SICKNESS FOR SPACE TRAVELERS [DIE BEDEUTUNE DER DRUCKFALLKRANKHEIT FUR DIE RAUMFAARER]

H. Hartmann [1963] 13 p In GERMAN Repr. from Proc. of the 12th Rocket and Space Travel Meeting of the Deutsche Raketen-Ges., Hamburg, 20–22 Sept. 1963 In GERMAN
(DVL-351)

Decompression sickness is reviewed. The etiology of decompression sickness is gas-bubble formation in the vascular system and in tissues. At an altitude of 12,000 meters, an air bubble is five times its original size. Since the lungs, due to the rib cage, cannot expand accordingly, excess pressure builds up in the lungs. The greater the volume of air in the lungs, the greater is the danger of decompression. In addition, greater heights can be more safely attained when the pressure drop does not follow normal pressure, but follows a low pressure level. Increased pressure in the lungs leads to a pressure increase in the pulmonary arteries that, in turn, can lead to air embolism in the brain and in the vessels of the heart. Performing a pneumothorax or a pneumoperitoneum operation has prevented air embolism in rats; it can also be conducted on man. All cases of decompression sickness should be treated in a pressurized chamber; however, flight physicians have had little or no experience with treatment in such a chamber, and very few such chambers exist. I.v.L.

N64-26710* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE HYDROLYSIS OF AMINO ACYL-β-NAPHTHYLAMIDES BY PLASMA AMINOPEPTIDASES
J. Ken Mc Donald, Thomas J. Reilly, and Stanley Ellis Repr. from Biochem. Biophys. Res. Commun., v. 16, no. 2, 1964 p 135–140 refs
(NASA-RP-236)

Investigations were conducted of the hydrolysis of amino acyl-β-naphthylamides by plasma aminopeptides. Results indicate that a variety of aminopeptidases can occur in blood plasma. At least three major aminopeptidases could be distinguished in plasma: (1) The aminopeptidase(s) of normal plasma, was predominantly thiol-independent, Co^{++}-activated, and puromycin-sensitive. The L-alanine-β-naphthlamide and L-methionine-β-naphthylamide were substrates most readily hydrolyzed by whole plasma. (2) The thiol-activated aminopeptidase(s), which appeared in plasma in association with tissue injury, was thiol-independent, Co^{++}-activated, and Mn^{++}-activated and puromycin-sensitive. The L-lysine-β-naphthylamide and L-argenine-β-naphthylamide were the preferred substrates. (3) Leucine aminopeptidase, which was only detectable in plasma in the event of tissue injury, was thiol-independent, Mn^{++}-activated, and puromycin-insenstitive. The L-leucine-β-naphthlamide was the substrate most readily hydrolyzed. I.v.L.

N64-26711* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
INHIBITION OF THIOL-ACTIVATED AMINOPEPTIDASE BY PUROMYCIN
Stanley Ellis and Manuel Perry Repr. from Biochem. Biophys. Res. Commun., v. 15, no. 6, 1964 p 502–505 refs
(NASA-RP-252)

Pituitary extracts have been shown to contain a thiol-activated aminopeptidase(s) that preferentially hydrolyzes dibasic amino acyl derivatives of p-nitroaniline and β-naphthylamine. In the course of recent studies, it was found that the thiol-activated aminopeptidase was strongly inhibited by puromycin. Leucine aminopeptidase, on the other hand, was not affected by puromycin either in the hydrolysis of p-nitroanilides or dipeptides by pituitary extracts. These findings provide a basis for distinguishing the action of the thiol-activated aminopeptides on p-nitroanilide substrates from that of leucine aminopeptidase, in addition to the already known differential effects of -SH on these two enzymes. The properties of the thiol-activated aminopeptidases, when considered in relation to the inhibition by puromycin, are suggestive of involvement in amino acyl s-RNA metabolism. I.v.L.

N64-26722 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ANTIBACTERIAL IMMUNITY AND RADIORESISTANCE
N. N. Klemparskaya, N. V. Rayeva, and V. F. Sosova 1 May 1964 154 p refs Transl. into ENGLISH from the book "Antibakterial'nyy Immunitet i Radiorezistentnost'" Moscow, Medgiz, 1963 p 1–118
(FTD-TT-63-933/1+2; AD-601549)

Immunological mechanisms, the reaction to autoantigenic substances, play an important role in the development of radiation sickness. It is possible to prevent the development of this reaction by immunological methods, one of which is vaccination. The administration of foreign antigens causes a complex reaction in which the nervous system and endocrine systems participate. After the initial symptoms of stress, Selye's alarm reaction, a prolonged characteristic reaction develops on the part of certain cellular elements, primarily the cells of the reticuloendothelial system and the plasmatic and lymphoid elements. The phagocytic functioning of the microphages and macrophages is activated. As a result of the specific change in globulin synthesis, immune bodies begin to develop not only to the antigen in question, the microbe, but also to tissue decomposition products. If vaccination is carried out before irradiation, immunity to the agent in question is not only maintained after exposure to ionizing radiation, but the course of the radiation sickness contracted is considerably altered. Vaccination conducted after irradiation does not have this effect on radioresistance. Two possible ways in which prophylactic vaccination may influence radioresistance are discussed. I.v.L.

N64-26725 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
RADIATION BIOCHEMISTRY
A. M. Kuzin 20 Mar. 1964 443 p refs Transl. into ENGLISH of the book "Radiatsionnaya Biokhimiya" Moscow, Izd. Akad. Nauk SSSR, 1962 p 1–310
(FTD-TT-63-661/1+2; AD-601546)

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1. PHYSICAL CHARACTERISTICS OF IONIZING RADIATION AND THEIR INTERACTION WITH MATTER p 15–28a refs
2. EFFECT OF IONIZING RADIATION ON WATER p 29–34 refs
3. FORMATION OF PEROXIDES BY IONIZING RADIATION p 35–43c refs
4. EFFECTS OF IONIZING RADIATION ON SIMPLE PROTEINS AND THEIR DECOMPOSITION PRODUCTS p 44–73b refs
5. EFFECT OF IONIZING RADIATION ON NUCLEIC ACIDS, NUCLEO-PROTEINS AND OTHER COMPLEX PROTEINS p 74–103d refs
6. EFFECT OF IONIZING RADIATION ON CARBOHYDRATES p 104–112a refs
7. EFFECT OF IONIZING RADIATION ON LIPIDS p 113–122b refs
8. EFFECT OF IONIZING RADIATION ON ENZYMES AND VITAMINS p 123–144b refs
9. EFFECT OF IONIZING RADIATION ON THE IN VIVO ACTIVITY OF ENZYMES p 149–182g refs

10. EFFECT OF IONIZING RADIATION ON THE STATE AND METABOLISM OF NUCLEOPROTEINS AND NUCLEIC ACIDS p 183–237h refs
11. EFFECT OF IONIZING RADIATION ON PROTEIN METABOLISM p 238–260h refs
12. EFFECT OF IONIZING RADIATION ON CARBOHYDRATE METABOLISM p 261–280e refs
13. EFFECT OF IONIZING RADIATION ON LIPID METABOLISM p 281–300g refs
14. EFFECT OF IONIZING RADIATION MINERAL METABOLISM p 301–313c refs
15. FORMATION OF TOXIC SUBSTANCES IN THE IRRADIATED ORGANISM p 314–334e refs
16. BIOPHYSICOCHEMICAL INTERPRETATION OF RADIATION INJURY IN CELLS p 335–373 refs

N64-26736 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RECONSTRUCTION OF MOLECULES

I. Shabanova 14 Jul. 1964 4 p Transl. into ENGLISH from Vechernyaya Moskva (USSR), 12 Feb. 1964 p 2
(FTD-TT-64-581/1+4; AD-602879)

Research is being conducted on the relationship between the chemical structure of a substance and its biological effect. Often a high therapeutical effect is accomplished by the substitution of one or two links in the complex molecule, and occasionally by the new spatial position of the parts of the same molecule. New compounds were developed with valuable therapeutic properties. For instance, on the basis of a well-known substance, phenothiazine, Chloroatsizine was developed by a complex synthesis. This drug is used in the therapy of stenocardia and infarct of the myocardium. As compared to other medicinals that dilate the vessels of the heart, the advantage of Chloroatsizine is that it does not lower the arterial blood pressure. It works effectively in a number of difficult cases where such common drugs as nitroglycerin, validol, and others are no longer helpful. Also Trimecain was prepared. This anesthetic is effective up to 48 hours and significantly alleviates the postoperative period. I.v.L.

N64-26757 Federal Radiation Council, Washington, D.C.

BACKGROUND MATERIAL FOR THE DEVELOPMENT OF RADIATION PROTECTION STANDARDS

Jul. 1964 19 p
(Rept.-5) GPO: $0.20

This report contains background material used in the development of guidance for Federal agencies in respect to planning protective actions to reduce potential doses to the population from radioactive fission products that may gain access to food, and doses at which implementation of protective actions may be appropriate. The material is directed to guidance concerned with protective actions affecting the normal production, processing, distribution, and use of food for human consumption when the action is taken because of the radioactive content of the food. Author

N64-26782* National Aeronautics and Space Administration, Washington, D.C.

PLASMA NONESTERIFIED FATTY ACIDS IN RATS SUBJECTED TO GRAVITATIONAL ACCELERATION [SODERZHANIYE NEESTERIFITSIROVANNYKH ZHIRNYKH KISLOT V PLASME KROVI U KRYS, PODVERGSHIKHSYA DEYSTVIYU USKORENIY]

A. A. Gyurdzhian, M. A. Lomova, and L. A. Radkevich Aug. 1964 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 151, no. 4, 1963
(NASA-TT-F-197) OTS: $0.50

Research was conducted on the plasma nonesterified fatty acids (NEFA) concentration in rats subjected to varying amounts of gravitational acceleration—2, 5, and 20 times gravity. Accelerative forces of 10, 15, 25, and 30 times gravity were also used in some experiments. The animals were exposed to the effects of acceleration for 5 minutes in a large laboratory centrifuge (radius = 36 cm). Each rat was placed in a single centrifuge tube, 1.5 liters in volume. Author

N64-26784* National Aeronautics and Space Administration, Washington, D.C.

RHYTHM VARIATIONS OF NEURONS OF THE RETICULAR FORMATION DURING LATERAL OVERLOADS (IZMENENIYE RITMIKI NEYRONOV RETIKULYARNOY FORMATSII PRI POPERECHNYKH PEREGRUZKAKH)

O. G. Gazenko et al Aug. 1964 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 155, no. 5 1964
(NASA-TT-F-230) OTS: $0.50

Under lateral overloads the activity of individual neurons of the reticular formation changes in phases. The nature of this change is expressed at first in an increase in rhythm frequency—activation phase; then in the form of grouping of impulses—grouping phase; and finally in complete absence of activity—silent phase. Author

N64-26836* National Aeronautics and Space Administration, Washington, D.C.

MICROBIOLOGICAL DEWAXING PROCESS YIELDING PROTEIN-VITAMIN CONCENTRATES

A. Champagnat, Ch. Vernet, B. Laine, and J. Filosa Aug. 1964 19 p refs Transl. into ENGLISH from Neftekhimiya (Moscow), v. 3, no. 5, 1963 p 799–810
(NASA-TT-F-233) OTS: $0.50

Earlier research on the growth of microorganisms based on hydrocarbons bore the character of basic or academic research. The present investigation was basically undertaken from the industrial standpoint, with a view to the mass production of proteins from unrefined petroleum fractions, under technologically and economically feasible conditions. The dewaxing of these fractions is accomplished by fermentation, which has certain advantages. Author

N64-26845 Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Research Inst.

EFFECTS OF SOME TRANQUILIZING, ANALEPTIC AND VASODILATING DRUGS ON PHYSICAL WORK CAPACITY AND ORTHOSTATIC TOLERANCE

R. V. Ganslen, B. Balke, F. J. Nagle, and E. E. Phillips Dec. 1963 10 p refs
(NIH G-6364)
(CARI-63-34)

Drugs for the control of psychosomatic disturbances have become so popular that their indiscriminate use could pose hazardous conditions in many facets of modern life requiring a high degree of mental alertness. In this study, attempts were made to explore the effects of one tranquilizing and two analeptic drugs on the physical working capacity and on cardiovascular responses to postural changes. A definite increase in work capacity was observed after ingestion of a combined caffeine-metrazol preparation, apparently resulting from an increased capacity for cardiac output and maximum oxygen intake. Recordil, a relatively new Italian drug and a very potent dilator of coronary arteries, also improved work capacity but caused a tendency for orthostatic syncope probably due to its generally vasodilating effects. The blood pressure depression observed with Equanil (from the meprobamate group) during rest, exercise, and tilting, especially with larger doses, raises the question

about the safety of people engaged in the operation of aircraft or motor vehicles when sedated by this drug. Serious incidents and fatal accidents may be precipitated by the emotional indifference to suddenly arising problems or as a consequence of delayed circulatory responses during flight maneuvers. Author

N64-26880 Joint Publications Research Service, Washington, D.C.
BIOLOGICAL EFFECTS OF GRAVITATIONAL ACCELERATION
Ye. A. Derevyanko and V. G. Mul'nikov 14 Aug. 1964 18 p Transl. into ENGLISH of an Article from Voprosy Psikhologii (Moscow), v. X, no. 3, May–Jun. 1964 p 131–139
(JPRS-25929; TT-64-41200) OTS: $1.00

The study of the gravitational-force effect on the pilot's biological mechanism is discussed as an index to information concerning the acceleration threshold. The tests were conducted in flight aboard a two-seater jet aircraft with the pilot enclosed in a cabin constructed from light material. In the range of g forces studied (0.8–1.2), the fundamental principle of stimulation, causing the appearance of acceleration sensations in man, is the process of change in the magnitude of g forces (gradient). The minimum gradient at which acceleration sensation appears is in a range from 0.01–0.02/sec. The latent period in which acceleration sensation appears is closely related to gradient. This relationship is expressed by an equation. The gradient of g forces from 0.01 to 0.02/sec gives the pilot information concerning the beginning of a change in the aircraft's position in space. A.L.B.

N64-26883 General Dynamics Corp., Groton, Conn. Electric Boat Div.
RESEARCH ON A WASTE SYSTEM FOR AEROSPACE STATIONS Technical Documentary Report, Apr. 1963–Jan. 1964
John Dodson and Harold Wallman Wright-Patterson AFB, Ohio. Aerospace Med. Res. Labs., May 1964 81 p refs
(Contract AF 33(657)-11489)
(U413-64-056; AMRL-TDR-64-33; AD-603013)

An engineering evaluation was conducted to select an optimum waste management system for collection, storage, and/or disposal of feces and urine in a space station under weightless conditions. Based on this study, a detailed design of an optimum waste management system was prepared for a 7-man, 15-day mission. Tests performed on a breadboard model of the feces collector demonstrated the feasibility of the selected approach. Author

N64-26905 Air Force Systems Command, Wright-Patterson AFB, Ohio Aerospace Medical Div.
PERFORMANCE PARAMETERS OF THE X-20 DYNA-SOAR PROTOTYPE FULL PRESSURE ASSEMBLY
Lee C. Rock May 1964 41 p refs
(AMRL-TDR-64-27; AD-603307)

The X-20 Dyna-Soar prototype model full pressure assembly was subjected to a series of tests to determine the performance parameters of the suit. These tests include those considered by Aerospace Medical Research Laboratories to be the basic standard performance tests for anthropomorphous protective assemblies in addition to those particularly requested by the Dyna-Soar Project Office. This report presents all the data obtained from the various tests and is presented as indicative of performance parameters only. No attempt was made to equate the assembly performance with the X-20 Dyna-Soar mission and vehicle performance or with the performance of any other anthropomorphous protective assembly. Author

N64-26906 Isomet Corp., Palisades Park, N.J.
CARBON DIOXIDE REDUCTION SYSTEM Technical Documentary Report Jan. 1962–Jan. 1964
H. Chandler Wright-Patterson AFB, Ohio, Aerospace Med. Res. Labs., May 1964 62 p refs
(Contract AF 33(657)-8066)
(AMRL-TDR-64-42; AD-603357) OTS: $1.75

An automatically operated carbon dioxide reduction system was developed, fabricated, and tested. The system was designed to reduce the carbon dioxide equivalent to that produced by one man, and to produce carbon and oxygen. A system such as this is required for providing respiratory support for man on extended space missions. The program was conducted in three phases—development of system components, experimental determination of system design parameters, and fabrication and testing of an engineering model. Successful operation of the engineering model demonstrated the feasibility and ease of operation of the system. Recommendations are made for improving the system and for future work. Author

17 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and materials fabrication, handling and inspection. *For related information see*: 06 Auxiliary Systems.

N64-25854 Joint Publications Research Service, Washington, D.C.
ELEMENTARY PRINCIPLES IN PNEUMOAUTOMATICS
T. K. Berenos et al 5 Jun. 1964 16 p refs Transl. into ENGLISH from Priborostr. (Moscow), no. 11, 1963 p 3–8
(JPRS-24950; OTS-64-31417) OTS: $0.50

The universal system of industrial pneumoautomatics consists of pneumoamplifiers, a pneumorelay, pneumoresistances, pneumocapacitors, and other analogs of electrical and electronic apparatus. All of these elements fulfill only the simplest functions and do not contain internal switching. Therefore, they are quite simple in construction, readily positioned, and of comparatively small scale. Assembly of the elements into circuits is carried out on special switching plates, through which pass all of the channels required for connecting all of these elements into a single circuit. It is possible, through the use of these elements, to realize algorithms of control, of any complexity, i.e., to build diversified controlling devices of continuous and discrete action and to construct relay surfaces of any desired complexity. I.v.L.

N64-25877 Ling-Temco-Vought, Inc., Dallas, Tex. Aeronautics Div.
ADVANCED THEORETICAL FORMABILITY MANUFACTURING TECHNOLOGY Third Interim Engineering Progress Report, 1 Dec. 1963–31 Mar. 1964
W. W. Wood, V. R. Russell, D. W. Truelock, G. M. Eberhart, W. J. Harris, Jr. et al Wright-Patterson AFB, Ohio, AF Mater. Lab., Mar. 1964 187 p refs
(Contract AF 33(657)-10823)
(ASD-TR-8-143(III); AD-438849)

The purpose of this project is to advance the technology of high-temperature and high-energy rate forming in the area of predicting and establishing forming limits, optimum forming temperatures, and optimum energy rates. The concept of

theoretical formability will be extended to generate data in these advanced areas of sheet metal forming. Most of the high-speed and high-temperature tensile and compression results are presented. These results are being used in developing indices to predict formability for the high-energy rate and the high temperature forming processes. Considerable data are presented in high explosive forming and high-temperature brake bending and deep drawing relating formability of actual parts to predicted formability from tension and compression specimens. Initial results indicate very good correlations between experimentally formed parts and the predicted limits based on formability indices. Author

N64-25920 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
CHEMICAL MILLING OF ALUMINUM HONEYCOMB ASSEMBLIES
F. Garlasco and R. Halley Apr. 1964 19 p refs
(ADR-08-17-64.1)

This program was initiated to develop a method of chemically milling aluminum honeycomb assemblies after they are bonded. A successful method would facilitate the fabrication of extremely thin-skinned assemblies and would also tend to reduce overall tooling costs. From several methods proposed, one was developed that is compatible with the operation of existing chemical milling facilities. A laboratory test program confirmed that most assemblies bonded with thermosetting adhesives, and not requiring a perforated core, can be chemically milled after bonding. Author

N64-25959* Harshaw Chemical Co., Cleveland, Ohio
THE MANUFACTURE OF CADMIUM SULFIDE THIN FILM SOLAR CELLS AT THE RATES OF 1 KILOWATT PER MONTH AND 5 KILOWATTS PER MONTH
J. C. Schaefer, R. W. Olmsted, and J. M. Mc Kenzie 29 May 1964 29 p
(Contract NAS3-2493)
(NASA-CR-54107) OTS: $2.60

This study determined the manpower, materials, and additional facilities necessary to produce the cadmium sulfide (CdS) thin film solar cell at the rates of 1-kw and 5-kw per month. Four courses of action were checked in some detail. The study indicated that reduced equipment costs and a choosing that course of action involving a modest amount of development of advanced equipment. Author

N64-26087 Argentina Comision Nacional de Energia Atomica, Buenos Aires
AN AUTOMATIC SOLDERING MACHINE FOR SEALING COMBUSTIBLE CYLINDRICAL ELEMENTS [UNA MAQUINA AUTOMATICA DE SOLDAR PARA SELLAR ELEMENTOS COMBUSTIBLES CILINDRICOS]
Oscar Wortman 1964 10 p refs In SPANISH *Its* Informe No. 104

Equipment designed and constructed for soldering covers to cylindrical aluminum cases that contain combustible ingredients is described. In this apparatus all of the soldering operations have been automated so that the soldered parts are reproducible and can be checked. The details and characteristics of the soldering are presented. Transl. by R.T.K.

N64-26094 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CURRENT STATE OF FOREIGN OPTICAL DISTANCE-FINDER TECHNOLOGY
V. P. Vasil'yev 27 Apr. 1964 16 p Transl. into ENGLISH from Izvest. Vyssh. Ucheb. Zaved., Geod. i Aerofotos. (Moscow), no. 2, 1957 p 73–81
(FTD-TT-64-182/1+2+4)

The state-of-the-art of foreign optical-distance-finder technology is discussed. The United States, in 1950, constructed and tested an optical distance-finder for geodesic purposes, operating on the principle of the ordinary pulse radar. Testing of this distance meter, referred to as an optical radar, indicated a relatively low measurement accuracy (on the order of two meters at a distance of 5 km). Greatest success in optical range-finder construction was achieved in Switzerland, beginning in 1950. Geodimeters were constructed that consisted of three basic units—the distance finder, the reflector, and the power supply. The principle of operation was based on the measurement of a phase shift. The operational distance of the instrument, under good visibility, reached 36 km, and the accuracy averaged about 1:300,000. In addition to the measurement of distance, the geodimeter may solve another important problem, i.e., the determination of the speed of light. A small-scale optical distance-finder, for measuring distances of 2 to 3 km, was developed in Germany. I.v.L.

N64-26121 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PREPARATION OF MOLYBDENUM SINGLE CRYSTALS BY ELECTRON-BEAM FLOATING-ZONE MELTING
Nai-Pen Ming, Ts'un-yi Fan, Ch'i Li, Yu-Shan Hsu, and Tuan Feng 10 Jul. 1964 12 p refs Transl. into ENGLISH from Mu Li Hsueh Pao (Nanking), v. 19, no. 3, 1963 p 160–164
(FTD-TT-64-350/1+2+3+4; AD-602629)

The present paper briefly describes the design and operation of a 1.5-kw electron-beam floating-zone melting unit. Using this unit, molybdenum single crystals were prepared, 4 mm in diameter and 2 to 5 cm long, and the laboratory technique of preparing single crystals with controlled orientation was mastered. The molybdenum single crystals prepared showed no preferred orientation; microscopic examination disclosed a large number of terraces on the crystal surface, with step heights ranging from 2.3×10^{-5} to 6.3×10^{-4} cm, which were tentatively identified as evaporation terraces. Author

N64-26186 Mechanical Technology, Inc., Latham, N.Y.
INVESTIGATION OF COMPLEX BEARING AND/OR LUBRICATION SYSTEMS FOR HIGH SPEED, HIGH TEMPERATURE OPERATION
P. Lewis, S. F. Murray, and M. B. Peterson Wright-Patterson AFB, Ohio, Flight Dyn. Lab., Jan. 1964 140 p refs
(Contract AF 33(657)-8666)
(FDL-TDR-64-12; AD-273864)

This report describes a program whose objective was to use complex or combined systems to permit operation over a wide temperature range at high speed and with a variety of ambient pressures. The program reviewed in detail the various individual items that constitute an overall system. Based upon the requirements and the results of the review, a rolling element bearing system with a solid lubricant circulating system was selected. Experimental results are presented that explore the feasibility of the elements making up the overall system. Author

N64-26195 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
A REVIEW OF DIMENSIONAL INSTABILITY IN METALS
F. C. Holden 19 Mar. 1964 43 p refs
(Contract AF 33(615)-1121)
(DMIC-MEMO-189; AD-602379)

Interest in maintaining very close dimensional control in precision parts has led to increased research activity in areas usually associated with the subject of dimensional stability. Included are the related phenomena of elastic limit determinations, microcreep, microstrain, the mechanisms that cause them, and the practical methods that can be employed to improve dimensional control. This paper discusses some of the problems that arise from dimensional instability. General recommendations are made for the processing of parts for use in applications where a high degree of dimensional stability is required. Author

N64-26198 Rock Island Arsenal Lab., Ill.
THERMAL STABILITY OF NINE HIGH TEMPERATURE FLUIDS AND THEIR INTERMIXTURES
R. Le Mar 24 Jan. 1964 37 p refs
(RIA-64-231; AD-602257)

The thermal stability of nine high-temperature fluids and their intermixtures was evaluated at 650° F for 16 hours under nitrogen in the presence of a set of four metal specimens consisting of aluminum, copper, steel, and monel metal. When each of the nine fluids was tested alone, polyphenyl ether and phenyl methyl polysiloxane displayed outstanding stability. Diphenyl bis-n-dodecyl silane, tetra (2-ethylhexyl)ortho silicate, deep dewaxed-super refined mineral oil and chlorinated biphenyl fluids showed good stability. Tritolyl phosphate, 2-6-ditert butyl 4-methyl phenyl di-n-butyl borate and pentaerythritol-mixed fatty acid ester fluids all displayed severe fluid degradation and, except for the borate, severe metal attack. As regards inter-fluid miscibility, the silane, chlorinated biphenyl, borate, and ester fluids showed complete miscibility with all the other fluids tested. Among the fluid intermixtures, 12 displayed good thermal stability. These generally consisted of combinations of the six most stable fluids. The polysiloxane, silane, and mineral oil fluids display the best compatibility with the other fluid types in terms of thermal stability. Conversely, the ester, chlorinated biphenyl, and phosphate fluids most frequently show deleterious interactions with the other test fluids. The metals most resistant to fluid attack were copper and aluminum. Author

N64-26199 RAND Corp., Santa Monica, Calif.
IMPACT OF EQUIPMENT LIFE CHARACTERISTICS ON MISSILE TEST PLANNING
L. T. Mast May 1964 19 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4102-PR; AD-602646)

Two conflicting bodies of opinion hold that the R&D missile and space system success rate can be improved by less prelaunch testing, or that the reliability of missiles can be enhanced by longer, more thorough testing and more extensive prelaunch operations. This paper presents data on both sides of this debate and examines the tradeoffs involved in finding the optimum point of operation to minimize the effect of both the wearout and infant mortality phenomena. From the conclusions drawn from the data, a test plan is proposed that would require all electronic and electromechanical subassemblies to be operated over long periods prior to use in the vehicle; the mechanical, hydraulic, and pneumatic booster subsystems to be operated for approximately one-tenth of their estimated mean life in order to have minimum risk during their short period of use; and a minimum of ground operation to be applied to the spaceborne pneumatic, hydraulic, and mechanical subsystems, unless their mean time between failures is very long. Author

N64-26204 Republic Aviation Corp., Farmingdale, N.Y. Manufacturing Research Dept.
ELECTRO-SPARK EXTRUDING Interim Technical Engineering Report No. 4, 1 Apr.–1 Jul. 1964
J. H. Wagner Wright-Patterson AFB, Ohio, ASD, Jul. 1964 24 p refs
(Contract AF 33(657)-11265)
(RAC-2491; ASD-TR-111(IV); AD-602483)

General design criteria consisting of working pressure, pressure source, shock loading, and preliminary specifications of a pressure vessel to perform capacitor discharge extrusion from a 200,000-psi fluid pressure are discussed. Design criteria for the container, liner, insert, and die assembly components are presented. A pumping system to obtain pressures to 200,000 psi are proposed. Shielding of equipment and other safety considerations in working with ultra-high pressures are outlined. Author

N64-26239 Naval Ordnance Lab., White Oak, Md.
FRICTION IN THE BEARINGS AND GEAR TRAIN OF A FLYWHEEL ACCELERATION INTEGRATOR
David L. Blanchard Oct. 1963 34 p refs
(NOLTR-63-127; AD-419648)

The objective of this study is to develop an equation of motion that accurately describes the motion of the flywheel of a mass-flywheel acceleration integrator. The initial problem is to write an accurate equation of motion for a coasting flywheel supported with radial ball bearings. Viscous and Coulomb frictional terms are included in this equation of motion. Experimental evaluation of these frictional terms reveals discrepancies in this mathematical model of ball bearing friction. Consequently, a single frictional term is included in the equation of motion. The results are very consistent, and the equations are much more straightforward. The torque loss, due to friction in radial ball bearings, is a function of the radial load raised to the 2.34 power, and the coefficient of friction is a function of radial load. From the results of the coasting flywheel analysis, an equation of motion is developed to describe the motion of the flywheel when coupled with an acceleration-sensing mass by a precision gear train. Agreement between predicted and observed flywheel motion is good for both the accelerated and coasting system. Author

N64-26240 Naval Ordnance Lab., White Oak, Md.
GYROSCOPIC EFFECT IN BALL BEARINGS OF FUZE ARMING VANE
Joanne E. Highdale and David L. Blanchard Oct. 1963 26 p
(NOLTR-63-167; AD-419224)

The rotating section of a fuse armed by a vane spinning in a windstream due to free fall was variously mounted with steel ball bearings, nylon ball bearings, and Teflon O-rings. Wind-tunnel tests were run and theoretical analyses made to determine the rise time and the steady-state speed of the vane as a function of the air speed. An expression for the steady-state velocity of the vane when mounted with ball bearings was developed, showing that gyroscopic action of the balls determined the maximum angular velocity of the vane; the theoretical results are in good agreement with experimental data. Author

N64-26260 Joint Publications Research Service, Washington, D.C.
PLANNING AND CALCULATION OF EXPERIMENTAL AND SCIENTIFIC RESEARCH WORK IN MACHINE BUILDING

V. D. Lavrov 8 Jun. 1964 142 p Transl. into ENGLISH from the Russian book Planirovaniye i Uchet Opytnykh i Nauchno-Issled. Rabot v Mashinostr. Moscow, 1961 p 3-45, 57-141 (JPRS-24993; OTS-64-31438) OTS: $2.75

In this book an account is given of the procedure in the planning and calculation of experimental and scientific research work in the Soviet machine building industry. Reviewed are the procedures in the development, approval and financing of long-term and annual thematic plans of experimental and scientific research work; the stages of its execution; the procedure in the introduction of new machines into series production, and the main ways to accelerate and reduce the cost of experimental production. Questions in fixing the norms of expenditures, the planning of expenditures, and calculating the execution of experimental and scientific research work are explained. Author

N64-26279 General Dynamics/Fort Worth, Tex. Convair Div.
MATERIAL—LUBRICATING OIL—GTO-790—IRRADIATION UNDER STATIC AND DYNAMIC CONDITIONS—EFFECTS OF
R. H. Mc Daniel 15 Apr. 1964 31 p refs
(Contracts AF 33(600)-38946; AF 33(657)-11214)
(FGT-2622; AD-437238)

A dynamic pump loop system was operated for 50 hrs in a nonnuclear environment to establish base line data on the functional fluid GTO-790. The system was then subjected to operation in a nuclear environment. Dynamic and static oil samples were taken periodically during both runs to determine physical and chemical property changes of the test fluids. Average bulk oil temperature within the static and dynamic reservoirs was 285° F. System operation was satisfactory during both runs. However, the irradiation run was terminated after 19.5 hr because of decreasing flash point values. As evidenced by test results, degradation of GTO-790 was severe during this phase. Contrary to findings on dynamic irradiation of other synthetic lubricating oils and hydraulic fluids, the effects of simultaneous dynamic operation and irradiation on GTO-790 fluid were not synergistic. Author

N64-26290 Sandia Corp., Albuquerque, N. Mex.
STANDARD ENVIRONMENTAL TEST METHODS
Jul. 1964 102 p
(SC-4452C(M); supersedes SC-4452B(M)) OTS: $2.25

This report presents minimum requirements in the form of process standards covering the instrumentation, equipment, and methods to be used in conducting environmental tests such as temperature, humidity, low pressure, mechanical shock, vibration, and acceleration. General guidance is included to help design, development, and test personnel achieve uniformity of testing. A checklist for preparation of the environmental testing portion of product specifications is also included to promote uniformity of specifications. N.E.A.

N64-26312 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
COMPARATIVE PERFORMANCE OF NON-CIRCULAR AND CIRCULAR WHEELS IN A SIMULATED LUNAR SOIL
Joel W. Schachter Jan. 1964 32 p refs
(ADR-04-05-63.2)

An investigation of locomotion on the lunar surface led to the testing of various noncircular and circular wheel forms in a simulated lunar type of soil to gather comparative performance data. The wheels tested were: the metalastic wheels (both spaced link and smooth), the elliptical wheel, and the rigid-circular wheel (having a diameter equal to the unloaded metalastic wheel). The wheels were evaluated by their performance in gross traction, drawbar pull vs. percent slip, rolling resistance, and tandem wheel tests. Author

N64-26313 Nuclear Metals, Concord, Mass.
DEVELOPMENT OF IMPROVED FABRICATION METHODS, PROCESSES, AND TECHNIQUES FOR PRODUCING TYPICAL AIRCRAFT SHAPES FROM BERYLLIUM Final Report, 15 Jul. 1962–30 Nov. 1963
R. G. Jenkins, J. M. Siergiej, A. K. Wolff, and J. L. Klein Wright-Patterson AFB, Ohio, AF Mater. Lab., 29 May 1964 134 p refs
(Contract AF 33(657)-8783)
(MI-9701.15; ML-TDR-64-108; AD-600520)

A basic procedure was developed for warm drawing long lengths of a complex beryllium structural shape to accurate dimensions. The starting shape was a U-channel extrusion having a 1 1/2-in.-wide web, 1-in.-high flanges, and a thickness of flange and web of 60 to 100 mils. Draw reductions of up to 16% were obtained in a single pass, and reductions of up to 39% were obtained by multiple draws. The maximum length drawn was approximately 10 ft. Large increases in longitudinal and transverse strength properties at room temperature and at −100° F are obtained by drawing at 800° F; on the average, the increase in yield strength is approximately 2,500 psi/1% drawing reduction. However, drawing reduces the ductility; for example, the longitudinal room-temperature ductility of approximately 6% is reduced to approximately 2% by a 14% draw reduction. Annealing after drawing reduces the strength but does not restore the ductility. Both strength and ductility are higher in the longitudinal direction than the transverse direction. The preferred orientation of the basal planes caused by extrusion is not changed appreciably by drawing. Author

N64-26342 Thiokol Chemical Corp., Brigham City, Utah Wasatch Div.
REINFORCED PLASTIC CONSTRUCTION METHODS FOR LARGE ROCKET MOTOR CASE. VOLUME II: CASE DESIGN AND FABRICATION Final Technical Engineering Report
W. G. Morse and F. W. Dallon Dec. 1963 242 p
(Contract AF 33(600)-42511)
(TR-63-7-858, Vol. II; AD-271908)

Case designs and fabrication processes were established for TU-226A, TU-226B, TU-227A, and TU-227B monolithic fiberglass-reinforced plastic cases. These cases were designed and fabricated to develop manufacturing methods for large (65-in. diameter or larger) plastic rocket motor cases. Case design included derivation of dome contours, analysis of dome, case cylinder, and skirt stresses, determination of component weights, and specification of glass filament size, resin system, case liner material, hardware, and case mandrels. Winding patterns and wrapping angles were evaluated by computer program for specific applications. Two cases of each design were fabricated, and at least one case of each design was subjected to hydroburst testing. The TU-226A (Lamtex) case withstood design pressure (1113 psig design; 1164 burst). The TU-227A (Allison) case also withstood design burst pressure (794 psig design; 1185 psig burst). Failures due to causes other than case rupture (forward skirt failure; aft cover plate failure) prevented attainment of case rupture for other cases. Author

N64-26343 Thiokol Chemical Corp., Brigham City, Utah. Wasatch Div.
REINFORCED PLASTIC CONSTRUCTION METHODS FOR LARGE ROCKET MOTOR CASE. VOLUME III: TU-228 CASE DESIGN AND FABRICATION Final Technical Engineering Report
W. G. Morse and F. W. Dallon Dec. 1963 89 p
(Contract AF 33(600)-42511)
(TR-63-7-858, Vol. III; AD-274622)

The case design and fabrication processes were established for a modular construction of fiberglass plastic cases. These cases were designed and fabricated to develop manufacturing methods for large (65-in. diameter or larger) plastic rocket motor cases. Case design included derivation of dome contours; analysis of dome, case cylinder, and skirt stresses; determination of component weights; and specification of glass filament size, resin system, case liner material, hardware, and case mandrels. Winding patterns and wrapping angles were evaluated by computer program for specific applications. Two small cases and one large case were fabricated and subjected to hydroburst testing. The design feasibility and fabrication techniques were successfully proven in subscale tests, in which the cases burst 143% and 162% of the design ultimate pressure. Although the larger case burst below design limit (proof) pressure (840 psi burst; 890 psi design), sufficient data, recorded from case behavior under pressure and from analysis of the mode of failure, permitted complete evaluation of the modular design. The stiffness of larger modules introduces deviations that affect case strength and performance under test. Author

N64-26344 Thiokol Chemical Corp., Brigham City, Utah Wasatch Div.
REINFORCED PLASTIC CONSTRUCTION METHODS FOR LARGE ROCKET MOTOR CASE. VOLUME IV: TU-290 CASE DESIGN AND FABRICATION Final Technical Engineering Report
W. G. Morse and F. W. Dallon Dec. 1963 93 p
(Contract AF 33(600)-42511)
(TR-63-7-858, Vol. IV; AD-278033)

From specifications and drawings, case designs and fabrication processes were established for the TU-290 monolithic fiberglass case. Phase III program requirements specified development, by progressive improvement of case design following fabrication, hydroburst, and evaluation, of a single nozzle case; a case to have a motor mass fraction (excluding igniter) of 0.965, and which could withstand 400,000 psi hoop stress at a burst pressure of 792 psig. The first three (of five) cases were hydroburst to evaluate designs, materials, winding equipment, and fabrication techniques. These cases withstood 575, 660, and 750 psig, respectively. The results for case No. 3 (379,000 psi hoop stress at 750 psig) were considered to satisfy design aims and objectives. The remaining two cases, fabricated with insulation, successfully withstood hydroproof testing at 550 psig. For subsequent tests on these cases, motor and nozzle designs were prepared. Author

N64-26345 Thiokol Chemical Corp., Brigham City, Utah Wasatch Div.
REINFORCED PLASTIC CONSTRUCTION METHODS FOR LARGE ROCKET MOTOR CASE. VOLUME V: MANDRELS Final Technical Engineering Report
W. G. Morse and F. W. Dallon Dec. 1963 85 p
(Contract AF 33(600)-42511)
(TR-63-7-858, Vol. V; AD-286687)

Mandrels were developed during this program for rocket motor use in R & D or in production programs. The mandrel design must be selected to accent flexibility of tooling for changes in case design, or to accent durability in repeated use, for economy in case production. Mandrel cost, weight, performance, and reliability must also be considered. A plaster or a plaster-shell-over-plywood construction readily permits changes in dome contours or case wall diameters. A cast mandrel of sand and resin, or a mandrel having extruded aluminum segments, requires a low capital outlay and permits high case production rates if the case configuration is fixed. The sand-resin mandrel is relatively heavy among the five designs used. The dimensional stability and the light weight of the extruded mandrel are positive assets for fabrication of fiberglass cases larger than 60 in. diam, but certain factors are not clearly defined—the reliability of its unique pressurization system and the potentially variable tension on glass fibers wound over aluminum. Author

N64-26346 Thiokol Chemical Corp., Brigham City, Utah Wasatch Div.
REINFORCED PLASTIC CONSTRUCTION METHODS FOR LARGE ROCKET MOTOR CASE. VOLUME VI: STRESS ANALYSIS Final Technical Engineering Report
W. G. Morse and F. W. Dallon Dec. 1963 247 p
(Contract AF 33(600)-42511)
(TR-63-7-858, Vol. VI; AD-296406)

To complete contractual requirements, a detailed stress analysis was completed for each case design developed in the program. Empirical equations for basic cylinder, dome, skirt, blast tube reinforcement, and metal parts design were derived, together with general equations for stability (buckling under load) and discontinuity analysis. Specific evaluation of each case design for these considerations was completed, together with an analysis of design deviation from general conditions, or analysis of redesigned portions, where appropriate. Following analysis, each case design was established as capable of withstanding all stresses imposed under normal flight sequence. Author

N64-26378 Joint Publications Research Service, Washington, D.C.
MATHEMATICAL SIMULATION OF OPERATION OF A SECTION MILL
V. V. Kobozev and A. I. Nazarenko *In its* Tech. Cybernetics 19 Jun. 1964 p 16–35 refs (See N64-26376 18-16) OTS: $4.00

Mathematical simulation of the operation of a section mill is investigated in a digital computer. As a basis for the simulation the method of statistical tests (Monte-Carlo) is assumed. A mathematical description of the process is given, and a diagram of the simulation algorithm is constructed. Some results are presented from investigation of one of the new section mills. Author

N64-26379 Joint Publications Research Service, Washington, D.C.
L. I. Feygin *In its* Tech. Cybernetics 19 Jun. 1964 p 36–44 refs (See N64-26376 18-16) OTS: $4.00

Necessary and sufficient conditions for the manufacture of n objects by m machines are investigated. A finite automatic network is synthesized that simulates the manufacturing process. Author

N64-26414* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
FUSED FLUORIDE COATINGS AS SOLID LUBRICANTS IN LIQUID SODIUM, HYDROGEN, VACUUM, AND AIR
Harold E. Sliney, Thomas N. Strom, and Gordon P. Allen Washington, NASA, Aug. 1964 19 p refs
(NASA-TN-D-2348) OTS: $0.50

Fused coatings of CaF_2-BaF_2 mixtures were effective solid film lubricants for nickel–chromium alloys submerged in liquid sodium at 1,000° F and sliding at a velocity of 2,000 ft/min. Under these conditions, the coatings were not damaged after 2 hours of sodium exposure. Coatings of LiF and CaF_2-LiF mixtures lubricated effectively in sodium, but LiF was slowly dissolved and could not be considered for prolonged exposure. These coatings also showed lubricating potential in hydrogen, vacuum, and air. Author

N64-26429 Monsanto Research Corp., Dayton, Ohio Dayton Lab.
DEVELOPMENT OF FIRE-RESISTANT WATER BASE HYDRAULIC FLUID
E. S. Blake, G. F. Deebel, and G. A. Richardson [1964] 16 p
(Contract NObs-90270)
(BR-1; AD-600703)

Partial alkyl ester alkali salts of phosphates and phosphonates are promising candidates as pour point depressants for fire-resistant, water-base hydraulic fluids. These compounds appear hydrolytically stable in alkaline solution at 200° F and possess high autoignition temperatures (AIT). The alkylphosphoramidates, because of their low AIT values, are of no value for this application. Mono-chlorination of an n-alkyl phosphate also makes no contribution to the AIT of the trialkyl ester. Water-soluble aromatic phosphates without hydrolytic stabilization are of no further interest. Author

N64-26477 Union Carbide Nuclear Co., Oak Ridge, Tenn.
PRECISION TURNING
F. H. Broome and V. M. Hovis 27 Jul. 1964 16 p refs
OTS: $0.50
(Contract W-7405-ENG-26)
(Y-1463)

Spherical test specimens possessing an overall dimensional conformity within ± 20 μ in. and a surface-finish value of 1 μ in. were made of aluminum, nickel, and copper. This high-quality finish was achieved by the direct use of single-point tool techniques without the usual additional work of lapping, buffing, or polishing. Machine tools are now available that are capable of microinch precision in supporting a work piece and guiding a diamond knife along a desired path during a cutting operation. Author

N64-26500 Bell and Howell Co., Chicago, Ill.
ASPHERIC OPTICAL ELEMENTS PROGRAM Interim Technical Report No. 19, 1 Jan.–31 Mar. 1964
Darryl Gustafson, Duwayne Stevens, and Wesley Van Ornum [1964] 19 p
(Contract AF 33(600)-37199)
(ITR-19; AD-600006)

Problems arising in the electronic control system of the machine, and in the temperature control system of the room in which the machine is located are discussed. The control system for the Y-axis stepping motor was unreliable, and steps were taken to correct this situation. The temperature control system did not prove adequate to stabilize the room temperature, and the variations that were encountered in the machine behavior because of this were beyond tolerable limits. It now appears that the room-temperature control was established and that variations fall within a total 1° range. A design of a 24-in. f/4.0 lens was undertaken as an alternate to the 48-in. f/4.0 lens. Author

N64-26501 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
AN ACTIVATION-ENERGY INDEX AS A CRITERION FOR DESIGN EXCELLENCE OF A GO, NO-GO SYSTEM
D. Bloom [1964] 22 p refs Presented at the SAE-ASME-AIAA Aerospace Reliability and Maintainability Conf., Washington, 29 Jun.–1 Jul. 1964
(Douglas Paper-1874)

Systems characterized by go, no-go may operate successfully even when they are close to failure. Often, in such systems, designers are faced with frustrating difficulties when they want to determine the effects of design changes on performance or reliability. A practical approach to solving such a problem is discussed. As an example, a system used for initiating ignition of a solid propellant motor is presented. An index, based on activation energy, is developed and used to establish a performance gradient that separates success from failure by a measurable amount. This index can be used to calculate the effects of design changes with respect to performance and reliability. The approach can be generalized to many systems. Author

N64-26502 Westinghouse Electric Corp., Baltimore, Md. Molecular Electronics Div.
CONTINUOUS PROCESSES FOR FUNCTIONAL ELECTRONIC BLOCKS Interim Technical Progress Report, No. 3, 1 Jan.–31 Mar. 1964
Wright-Patterson AFB, Ohio Aeron. Systems Div. [1964] 48 p
(Contract AF 33(657)-11204)
(ASD-TDR-8-133-3; AD-600847)

This report covers work to substantially improve the oxidation, etching, and diffusion processes as they apply to functional electronic blocks and other planar semiconductor devices. Work toward the final goal of an operating line based on the principle of continuous processing proceeded through model testing of basic design features to the design of prototype unmechanized machines, and to the actual construction and testing of manually operated prototype machines. The work mainly involved the construction of machines that embody the basic process and mechanical configuration of the final operating line without its mechanization of parts feed. The emphasis was on obtaining early operational models of the basic machines so that evaluation and debugging might start before final design of the line is completed. Author

N64-26584 Ampex Corp., Redwood City, Calif.
AXISYMMETRICAL FOIL BEARING—COMPRESSIBLE FLOW
E. Barlow Jun. 1964 30 p
(Contract Nonr-3815(00))
(RR-64-6; AD-602460)

The axisymmetrical foil bearing is studied with effects of compressibility being included. The pressure and gap profiles are found by numerically integrating the governing equations. The results are compared with the corresponding results obtained in a previous report on an approximate solution of the same problem assuming incompressible flow. Author

N64-26617 International Resistance Co., Philadelphia, Pa. Research and Development Div.
INDUSTRIAL PREPAREDNESS MEASURE: RESISTORS, FIXED, FILM TYPE, GENERAL PURPOSE (HIGH STABILITY) Final Engineering Report, 8 Jun. 1959–26 Dec. 1963
Jerome G. Burns [1963] 213 p refs
(Contract DA-36-039-SC-81283)
(AD-600753)

Product and process development work was carried out in order to incorporate a resistor process, previously developed on a laboratory scale, into a highly automated production facility. Most of the work was directed toward the development of a satisfactory resistive film and a termination system. Materials and methods included in the research work were concerned with chromium, molybdenum, and tungsten carbonyl compounds; pyrolysis of hydrocarbon vapors upon silica glass tubular substrate; and carbon films. Pilot plant production and testing of the various resistors are described along with a reliability analysis. P.V.E.

N64-26638 Raytheon Co., Lewiston, Me. Semiconductor Div.

PRODUCTION ENGINEERING MEASURE: RELIABILITY IMPROVEMENT SILICON ALLOY TRANSFER, VOLUME I Final Engineering Report, 25 Jun. 1962–26 Dec. 1963

R. W. Jones, A. W. Postletwaite, and L. F. Leary [1963] 134 p refs

(Contract DA-36-039-SC-86744)

(AD-600024)

Values and controls for silicon resistivity, lifetime, orientation, and crystalline perfection were determined. Chip dimensional tolerances were tightened. The mechanical design and methods of assembly were changed to give lower T_j, to permit higher stressing levels, and to insure cleaner junctions. Electrolytic and vibratory etching were developed and optimized. Electrolytic rinsing was introduced. Improved basecoat curing and nitrogen packaging were implemented. A combination of 200° C bake and 400 mw burn-in post seal stabilizing stress was proven optimum. The use of a thermographic phosphor to monitor 100% burn-in made this operation statistically significant. Power step stress as a rapid reliability ranking method was shown to be effective. A production run was carried out and the improved reliability of the product demonstrated. A complete process manual, an approved inspection and quality control plan, consolidated production run data, including yields, parameter distributions, and characteristic parameter curves, and photographs of all special equipment are included as required by the contract. Author

N64-26709 Varian Associates, Beverly, Mass. Bomac Div.

NOISE SOURCE FOR MILLIMETER WAVELENGTH Quarterly Progress Report, 1 Oct. 1963–1 Jan. 1964

Arnold M. Eklund [1964] 22 p

(Contract DA-36-039-AMC-03229(E))

(QPR-2; AD-600246)

The major portion of this period was spent in the evaluation of the 3.2-mm test equipment and the construction and cold test of both the hot load and the gas noise source geometry. The silicon carbide hot load is matched to standard RG 99/U waveguide with a VSWR maximum of 1.05 at both 70.0 Gc and 94.0 Gc. The gas noise source preliminary design has both a cold and a simulated fired match, which varies from 1.3 to 2.0 in VSWR, depending on small changes in quartz diameter and thickness. Author

N64-26731 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

MAGNETIC-AIR BRAKE FOR TEST OF MICRO-TURBINES

V. M. Dorofeev, A. S. Natalevich, and N. T. Tikhonov 21 May 1964 11 p ref Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekh. (Kazan), no. 4, 1962 p 123–128

(FTD-MT-63-293; AD-428818)

A magnetic airbrake installation is discussed that provides smooth and continuously variable regulation of the braking torque during measurement of the power of air (gas) microturbines, with a number of revolutions to 100,000 per minute, and a maximum power of 3.5 horsepower at n=50,000 rpm. The sensitivity of the scales of the installation is ±0.2 g that on an arm of 14.29 cm gives a torque of 2.858 g/cm. T.v.L.

N64-26748 Joint Publications Research Service, Washington, D.C.

AN ALGORITHM FOR USE WITH DIGITAL PROGRESS-CONTROL COMPUTERS FOR DETERMINING THE TIME AT WHICH BLOW-OUT SHOULD STOP WHEN A GIVEN CARBON CONTENT IS REACHED IN A BESSEMER CONVERTER

K. S. Garger et al 6 Aug. 1964 10 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Chern. Met., no. 3, Mar. 1964 p 47–52

(JPRS-25762; TT-64-41033) OTS: $1.00

A diagram is given of the automatic control system of a Bessemer unit that uses a GPCC (general purpose control computer). The system issues caution and terminal signals when teeming occurs in the converter. The problem of automatically stopping a melt in a Bessemer converter consists of determining the time at which a teeming signal should be transmitted, so that the carbon content in the metal during teeming is within a preset interval. An algorithm for determining the periods in a melt reduces to determining the points t_1 and t_2, by using repeated differentiation of the cavity-radiation pickup curve. The second derivative of the curve has local extrema at points t_1 and t_2. At point t_1 it has a maximum, and at point t_2 it has a minimum. R.T.K.

N64-26797 Oak Ridge National Lab., Tenn. Analytical Chemistry Div.

FABRICATION OF THE VERTICLE-ORIFICE TEFLON CAPILLARY OF A TEFLON DROPPING-MERCURY ELECTRODE

Helen P. Raaen and Ralph L. Clark Aug. 1964 24 p refs

(Contract W-7405-ENG-26)

(ORNL-3654)

A procedure was developed for fabricating the vertical-orifice Teflon capillary of a Teflon dropping-mercury electrode (D.M.E.). The capillary will be used for rapid polarography of glass-corroding solutions. Special tools were designed and built for use in the fabrication. The fabrication procedure is a modification and extension of that developed earlier for making Teflon D.M.E. capillaries that have the orifice in the horizontal plane. By means of a micro drill press and a micro drill, the vertical orifice is drilled in a lapped vertical face of the capillary blank. During the drilling, the capillary blank is held in a special jig, which is mounted on the table of the drill press. If the desired orifice diameter is about 100μ or larger, a micro twist drill is used; for smaller diameters, a micro pivot drill is used. Several capillaries that have orifice diameters of about 70μ and 100μ were made. Author

N64-26798 Oak Ridge National Lab., Tenn. Metals and Ceramics Div.

CHARACTERIZATION OF SPHEROIDAL UO_2 PARTICLES AND STUDIES OF FABRICATION VARIABLES FOR CORE B FUEL PLATES OF THE ENRICO FERMI FAST BREEDER REACTOR

A. J. Taylor, J. H. Cherubini, J. M. Robbins, and M. P. Haydon Aug. 1964 68 p refs

(Contract W-7405-ENG-26)

(ORNL-3645) OTS: $1.75

During roll cladding, dispersions of spheroidal UO_2 in stainless steel often suffer particle degradation that leads to unacceptable fuel plates. Several physical tests on commercially produced −100 +140 mesh spheroidal UO_2 were evaluated as criteria for particle quality by correlation of the results with microstructures of the roll-clad dispersions. Determinations of microhardness, crushing strength by a simple test, attrition resistance, grain size, and surface area did not satisfactorily characterize the particles. A rapid mercury pycnometric technique, despite inaccuracy, could distinguish both the highest grade and the poorest grade of UO_2 spheroids, but could not clearly distinguish between the intermediate grades that may sometimes be acceptable. A more complete characterization was obtained by density determination and microscopic observation on particles embedded in an epoxy resin. A study of the effect of rolling temperature on plate quality

revealed an optimum furnace temperature of 1,150° C, somewhat lower than previously established. Core-clad bonding is best for this rolling temperature. Lower temperatures gave improved surface finish but excessive particle degradation. The quality of poorer grades of UO_2 was improved by firing in hydrogen at 1,750° C. Cold rolling of dispersion plates degraded both superior and poor quality particles similarly. Particle degradation was less in plates fabricated by a more severe hot-rolling schedule. Author

N64-26814 General Dynamics/Astronautics, San Diego, Calif.
COMPILATION OF GENERAL DYNAMICS/ASTRONAUTICS MATERIALS RESEARCH DATA Technical Memorandum, 1 Mar. 1961–27 May 1963
George Young and Richard Klinger Wright-Patterson AFB, Ohio, ASD 28 May 1963 20 p refs
(Contract AF 33(616)-7984)
(ASRCE-TM-63-15; AD-408731)

Test reports generated between March 1, 1961 and May 27, 1963 are listed. Only those reports are listed that contain pertinent mechanical and physical properties data for various materials, and are sufficiently documented so as to be considered as containing reliable information. P.V.E.

N64-26817 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON THE SIMILARITY OF SYSTEMS OF REGULATING GAS TURBINES
Ye. M. Syuzyumova 28 Feb. 1963 15 p refs Transl. into ENGLISH from Tr. Vses. Nauchn.-Issled. Inst. Zheleznodor. Transp. (USSR), No. 214, 1961 p 52–62
(FTD-TT-62-1815/1+2+4; AD-400547)

The use of similarity methods for investigating regulatory systems involves the transition to relative coordinates and relative times. In the example of the simplest, linear, turbine regulatory system with one stress, the equations for the system depend on five parameters; successive similarity transformations with the use of the relative coordinate method led to a system dependent on one parameter. The application of the method to more complex systems and the extension of the results to a family of similar regulatory systems are presented. D.S.G.

N64-26824 Aeroprojects, Inc., West Chester, Pa.
ULTRASONIC WELDING PROCESS AND EQUIPMENT FOR CONSTRUCTION OF ELECTRON-TUBE MOUNTS Quarterly Progress Report, Jan. 1–Mar. 31, 1963
William Rosenberg [1963] 125 p refs
(Contract DA-36-039-SC-86741)
(QPR-3; AD-423699)

Results of welding all the required combinations of materials and geometries are presented. Tensile-shear strength data and metallographic evaluation for successfully welded combinations are reported. The requirements for ultrasonic welding in the manufacture of three specific electron tubes were established. Author

N64-26903 Pfaudler Co., Rochester, N.Y.
DEVELOPMENT OF PRACTICAL TECHNIQUES FOR APPLYING PROTECTIVE COATINGS TO COLUMBIUM ALLOYS Technical Documentary Report Jun. 1962–May 1963
J. Zupan, P. J. Chao, J. B. Whitney and D. H. De Clerk Wright-Patterson AFB, Ohio, Res. and Technol. Div., Sep. 1963 71 p
(Contract AF 33(657)-8920)
(RTD-TDR-63-4063; AD-603111)

Three coating processes—fused salt bath, fluidized bed, and slurry dip application—were investigated to develop practical and reliable techniques for applying oxidation protection coatings to columbium alloys. The substrate used was D-14 (Cb-5Zr). Only coatings of known composition were applied. Titanium, chromium, and silicide coatings were deposited by the fused salt bath process; silicide coatings by the fluidized bed; and tin and aluminum coatings by slurry application. Early in the program, the work on slurries was expanded to include a study of their electrokinetic behavior. The several process variables pertinent to each technique were evaluated to determine the range of operating conditions that can be used to produce the desired coating. All coatings were tested for oxidation resistance at 2,500° to 3,000° F. Further evaluation included metallographic examination of the coated samples. The program resulted in the development of several suitable coatings. Work is being continued to demonstrate further the feasibility of these coating techniques. Author

18 MATERIALS, METALLIC

Includes cermets; mechanical and physical properties of alloys and metals; and metallurgy. *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 19 Materials, Nonmetallic; 33 Stresses and Loads; and 34 Structural Design.

N64-25852 Joint Publications Research Service, Washington, D.C.
RESEARCH ON HEAT-RESISTING ALLOYS
29 May 1964 33 p refs Transl. into ENGLISH of 5 Articles from the book "Issled. po Zharoprochnym Splavam Tom V" Moscow, Inst. of Met., USSR Acad. of Sci., 1959
(JPRS-24845; OTS-64-31371) OTS: $1.00

CONTENTS:

1. DISLOCATION THEORY IN CONNECTION WITH TEMPERATURE DEPENDENCE OF DUCTILITY IN STEEL V. G. Savitskiy and K. V. Popov p 1–6 refs
2. CAST AUSTENITIC STEELS FOR OPERATION AT 650–750° G. P. Fedortsov-Lutikov et al p 7–14
3. IMPROVING QUALITY AND DEFORMABILITY OF ALLOYS AND ALLOY STEELS BY ELECTROSLAG REMELTING IN A WATER-COOLED METAL CRYSTALLIZER Ye. Ye. Paton et al p 15–20
4. PRODUCTION OF FORGINGS FOR TURBINE AND COMPRESSOR BLADES B. N. Batagov et al p 21–24
5. APPLICATION OF CERAMIC COATING BY ELECTROPHORESIS A. P. Obukhov et al p 25–30 refs

N64-25853 Joint Publications Research Service, Washington, D.C.
RESEARCH IN TITANIUM ALLOYS
29 May 1964 92 p refs Transl. into ENGLISH of 8 Articles from Titan i Yego Splavy (Moscow), no. 10, 1963
(JPRS-24859; OTS-64-31378) OTS: $2.25

CONTENTS:

1. CORROSION RESISTANCE OF TITANIUM ALLOYS TO TECHNOLOGICAL MEDIA IN CHEMICAL-PHARMACEUTICAL PLANTS F. N. Tavadze et al p 1–5
2. CORROSION RESISTANCE OF AT TITANIUM ALLOYS TO PRODUCTION MEDIA OF THE FOOD INDUSTRY F. N. Tavadze and T. A. Lashkhi p 6–15

3. THE KINETICS OF HYDROGEN EXTRACTION IN VACUO FROM TITANIUM MATERIALS B. S. Krylov p 16–31

4. INVESTIGATION OF COMPOSITIONS AND PROPERTIES OF INDUSTRIAL MELTS OF TITANIUM ALLOY AT-3 V. A. Livanov et al p 32–41

5. DEVELOPMENT OF TECHNOLOGY FOR PIPE PRODUCTION FROM TITANIUM ALLOY AT-3 V. Ya. Ostrenko et al p 42–54

6. THE BRAZING OF TITANIUM ALLOY AT-3 WITH VARIOUS GALVANIC COATINGS A. Ya. Shinyayev and V.V. Bondarev p 55–61 refs

7. THE USE OF TITANIUM ALLOYS AT-3, AT-4, AT-6, and VT-3-1 FOR COMPRESSOR IMPELLERS OPERATING IN VARIOUS CORROSIVE MEDIA N. I. Belan et al p 62–80

8. INVESTIGATION OF THE PROPERTIES OF TITANIUM ALLOY AT-4 IN APPLICATION TO THE CONDITIONS OF PIPE PRODUCTION V. Ya. Ostrenko et al p 81–89

N64-25863 Hanford Atomic Products Operation, Richland, Wash. Hanfords Labs.
METALLURGY RESEARCH OPERATION Quarterly Progress Report, Jan., Feb., Mar. 1964
J. J. Cadwell 15 Apr. 1964 148 p refs
OTS: $2.75
(Contract AT(45-1)-1350)
(HW-81269)

Research in the following areas is summarized: (1) physical metallurgy—neutron damage to metals, swelling of irradiated fissionable materials, and plutonium physical metallurgy; (2) reactor metals research—alloy selection, in-reactor measurements of mechanical properties, irradiation facilities operation, irradiation damage to zircaloy-2, irradiation damage to nickel-base alloys, basic fracture studies, low-cycle fatigue studies, and damage mechanisms; (3) chemical metallurgy—environmental effects, materials development, production reactor corrosion and coating studies, and *N* reactor corrosion and hydrogen studies; and (4) materials engineering—gas loop development and pressure tube development. P.V.E.

N64-25864 California U., Livermore Lawrence Radiation Lab.
EFFECTS OF WATER VAPOR AND OTHER GASES ON URANIUM, THORIUM, PLUTONIUM, AND CARBIDES. A BIBLIOGRAPHY
Brigitta M. Dobratz [1964] 20 p
(Contract W-7405-ENG-48)
(UCRL-7836) OTS: $0.50

Corrosion of reactor fuel elements has long been a problem. Several bibliographies have been published on this subject. With the rapidly increasing number of publications in this field, scientists have requested that a literature search be conducted in the specific area of corrosion effects on these materials by water vapor, steam, moist air, and gases. This bibliography contains selected references, mainly from report literature, on corrosion and oxidation of plutonium, thorium, and uranium, as well as their carbides, by water vapor and gases, for the period 1951 to 1964. Author

N64-25866 Atomics International, Canoga Park, Calif.
BIBLIOGRAPHICAL SURVEY OF SWAP FUEL MATERIALS: ZIRCONIUM-URANIUM HYDRIDE AND RELATED ZIRCONIUM AND URANIUM SYSTEMS, VOLUME I
A. W. Barsell, L. D. Montgomery, and J. T. Roberts [1964] 220 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9525, Vol. I) OTS: $3.00

A two-volume bibliographical survey of SNAP fuel materials, reviewing all investigations conducted on zirconium-uranium-hydrogen systems, is presented. Recent unclassified publications on the indivudual metals, alloys, oxides, and hydrides are included in appendix form. Emphasis was placed upon experimental, quantitative data resulting from the investigations in their respective temperature and composition ranges. Also, particular interest was given to thermodynamic property data obtained in these related studies, and these data are subject-indexed for each material with the respective temperature ranges. Abstract data may be found either through author's name, subject matter, or report number indexes common to and appearing in each volume. Author

N64-25899 Battelle Memorial Inst., Columbus, Ohio
SURVEY OF CURRENT KNOWLEDGE OF THE DEFORMATION CHARACTERISTICS OF BERYLLIUM AND THE REFRACTORY METALS Quarterly Progress Report, Dec. 15, 1963 – Mar. 13, 1964
F. W. Boulger, A. R. Rosenfield, and D. E. Strohecker 22 Apr. 1964 85 p refs
(Contract N600(19)-60240)
(QPR-3; AD-600363)

The technical effort was concentrated on preparing interpretive reports on the extrusion process, and on the mechanisms and effects of dynamic strain aging. Author

N64-25911* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF PREOXIDATION TREATMENTS ON SPECTRAL NORMAL AND TOTAL NORMAL EMITTANCE OF INCONEL, INCONEL-X, AND TYPE 347 STAINLESS STEEL
Wayne S. Slemp Washington, NASA, Jul. 1964 58 p refs
OTS: $1.50
(NASA-TN-D-2300)

The spectral-normal-emittance values of several oxidized surfaces prepared by varying the preoxidation treatments or oxidation time for Inconel, Inconel-X, and type 347 stainless steel were determined at temperatures of 900°, 1,200°, 1,500°, and 1,800° F over a wavelength range of 1μ to 15μ. Polishing, grit blasting, etching, or combinations of these preparations were used as preoxidation treatments. These values were compared for 900° and 1,800° F to determine the effects of these treatments on the spectral-normal-emittance values. Author

N64-25923 Grumman Aircraft Engineering Corp., Bethpage N.Y. Special Projects Section
INVESTIGATION OF THE EFFECT OF QUENCH MEDIA ON ELECTRICAL AND MECHANICAL PROPERTIES OF 6061 ALUMINUM
Alvin A. Machonis and William Wolkowitz Feb. 1964 21 p refs
(RM-228)

To minimize distortion in heat treatable aluminum alloys, it is sometimes desirable to quench from the heat treat temperature in various media other than those generally considered. The effect of the quench medium in the subsequent aging process is not well understood. Therefore, to gain a deeper understanding, a study was made of the relationship between electrical resistivity and mechanical properties of 6061 aluminum alloy sheet metal subjected to various quench media. Tensile specimens of 6061 aluminum sheet 0.062-in. thick were machined into suitable specimens, and their resistivities were measured. The specimens were then quenched in various media from a solution temperature of 970° F. Resistivity was measured before and after aging. The strength properties of the alloy were measured after aging, and the change in resistivity was correlated with the strength. The quenchant was influential in affecting the

final values of resistivity and mechanical properties. The degree of influence will probably be altered by the interrelationship of the quenchant properties and the surface area to volume ratio of the specimen. Further experimental work is recommended to determine if the aging treatments should be tailored to the quenchant to optimize the properties. Author

N64-25949* Westinghouse Electric Corp., Pittsburgh, Pa., Astronuclear Lab.
DEVELOPMENT OF DISPERSION STRENGTHENED TANTALUM BASE ALLOY Third Quarterly Progress Report, 20 Dec. 1963–19 Mar. 1964
R. W. Buckman, Jr. and R. T. Gegley [1964] 74 p refs
(Contract NAS3-2542)
(NASA-CR-54105; WANL-PR-(Q)-003) OTS: $7.60 ph

The objective of this program is the development of a dispersion-strengthened tantalum-base alloy for use in the 2,400° to 3,000° F temperature range of advanced space-power systems. The alloys are being developed primarily from the Ta-W-Hf-C system with limited substitution and/or additions of Re and Mo, Ar, and N for the tungsten, hafnium, and carbon, respectively. A total of 29,800 gram nonconsumably melted compositions, at the tantalum-rich end of the Ta-W-Hf-C system, were prepared and processed to sheet. The ability to be fabricated and welded was affected by the total solute addition, total carbon addition, and the ratio of the reactive (HF) metal addition to the carbon addition. A series of compositions with substitution and/or additions of molybdenum and rhenium, zirconium, and nitrogen for the tungsten, hafnium, and carbon, respectively, were melted, upset forged, and processed to 0.04-inch-thick sheet; and six compositions melted as 2-inch-diameter ingots were processed to 0.04-inch-thick sheet. R.T.K.

N64-25987 Air Force Systems Command, Wright-Patterson AFB, Ohio Systems Engineering Group
BREAKING-STRENGTH AND ENDURANCE TESTS OF ALUMINUM TURNBUCKLES FOR AIRCRAFT Technical Documentary Report, Jul.–Nov. 1963
Perry L. Smith Mar. 1964 24 p
(SEG-TDR-64-2; AD-600169)

Breaking-strength and endurance tests were run to make possible a partial evaluation of the strength of turnbuckle bodies fabricated from 2024T6 aluminum alloy. Aircraft control cable turnbuckles and fittings were exposed to extremes of temperature, salt-water spray, buffeting, and low-amplitude high-frequency vibration. Failures in the aluminum bodies occurred at the transverse hole drilled through the middle of the body. When the aluminum body is modified so that the opening area is 0.057 in., failures at the transverse hole can be eliminated. Tests of brass and aluminum bodies showed that the ratio of average tensile strength to weight of aluminum bodies was 61% better than for the brass bodies. When aluminum barrels were used instead of brass barrels, a saving of approximately 7 lbs could be realized for bodies used with a cargo or bomber-type aircraft. Author

N64-25998 North American Aviation, Inc., Los Angeles, Calif.
INFORMATION ON PROPERTIES OF NAA-85 PROTECTIVE COATING SYSTEM
14 Jun. 1963 9 p refs
(TFD-63-522)

The NAA-85 coating system is applied by spraying, dipping, or brushing from a slurry containing aluminum and ceramic powders, followed by a diffusion treatment at 1,900° ±50° F for 1 to 2 hours in an inert atmosphere. The following properties of NAA-85 protective coating system are described: oxidation resistance, emittance, and diffusion stability. Also discussed are: X-15 boundary-layer rake assemblies, hypersonic leading-edge test structure, and Apollo engine skirt test structures. R.T.K.

N64-26029 Iowa State U. of Science and Tech., Ames Ames Lab.
HIGH VACUUM LIQUID METAL DISTILLATION: AN ANNOTATED BIBLIOGRAPHY
D. E. Westerheide (Gen. Dyn./Fort Worth) and George Burnet May 1964 29 p refs
(Contract W-7405-ENG-82)
(IS-799) OTS: 0.75

This annotated bibliography consists of a chronological survey in which each reference is identified by investigators and the work reported briefly summarized, and a conventional bibliography arranged in alphabetical order by investigator. References selected deal with the theory and practice of high vacuum liquid metal distillation and cover the period from 1912 through 1963. All pertinent publications appearing in Chemical Abstracts and Nuclear Abstracts were included as were several unpublished theses. Author

N64-26040 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
STRESS CORROSION OF ALUMINUM ALLOYS
F. T. Main, Jr. 19 Oct. 1963 7 p refs
(ADN-02-16-63.1)

This note reports the results of further stress corrosion tests on welded 5456 aluminum alloy. The results indicate that a stress relief cycle of 15 minutes of 525° F following welding does not adversely affect the stress corrosion resistance of the weldment. Author

N64-26059 IIT Research Inst., Chicago, Ill. Technology Center
EMBRITTLEMENT OF METALS BY ORGANIC LIQUIDS Quarterly Report, 1 Mar.–31 May 1964
1 Jun. 1964 15 p
(Contract DA-11-ORD-022-3108)
(IITRI-B183B2-5; AD-600695)

By a test involving a combination of static and dynamic loading, the carboxylic acids are shown to be embrittling to high-strength steel to a degree proportionate to the carbon chain length. Nonpolar liquids are in general not embrittling, but the magnitude of the dipole moment is not a measure of embrittling propensity. Present evidence indicates that under appropriate conditions, a -Cl group is potentially as embrittling as an -OH or a -O- group. Author

N64-26070 Compagnie Industrielle des Combustibles Atomiques Frittes, Corbeville Par Orsay (France)
EXTRUSION OF URANIUM BIOXIDE [FILAGE DE L'OXYDE D'URANIUM]
J. Mercier Brussels, EURATOM, Apr. 1964 53 p in FRENCH
(Euratom-070-62-5 RDF)
(EUR-547.f) Available from Belgian American Bank and Trust Co., N.Y., Account no. 121.86: 70 Belg. Fr.

Different ceramic grade UO_2 powders have been tested under the extrusion process. The study has been made on 12 powders that differ considerably from one another so far as preparation and physical characteristics are concerned. The reproducibility of the process was also studied, and it was found that on several batches of powders made under similar conditions sintered densities were close to each other and largely above 95% of the theoretical density. On the economical side, it was shown that different types of presses

were convenient and that it was possible to recycle scraps directly without refining them. Author

N64-26093 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INVESTIGATIONS ON HEAT-RESISTANT ALLOYS Selected Articles
30 Mar. 1964 91 p refs Transl. into ENGLISH from Issl. po Zharoprochnym Splavam, Inst. Metallurgii, An SSSR, v. 9, 1962 p 42–46, 66–72, 87–88, 133–139, 187–192, 218–248 (FTD-MT-63-206; AD-442630)

CONTENTS:

1. REGULARITY OF DIFFUSION OF NICKEL IN ALLOYS ON NICKEL BASE IN COMPARISON WITH HEAT-RESISTANT PROPERTIES OF THESE ALLOYS S. D. Gertsriken, L. F. Slastnikova, T. K. Yatsenko, T. I. Volkova, and I. L. Mirkin p 1–9 refs
2. INCREASE OF CRITERIA OF STRESS-RUPTURE STRENGTH DURING THERMO-MECHANICAL TREATMENT I. A. Oding and Z. G. Fridman p 10–18 refs
3. DISCUSSION p 19–22
4. THE BEHAVIOR OF MATERIALS IN CONDITIONS OF PROTRACTED ACTION OF CYCLICAL THERMAL STRESSES Yu. F. Balandin p 23–33
5. INCREASE OF HEAT RESISTANCE OF ALLOY EI-867 WITH THE HELP OF ALUMINUM COATING D. V. Ignatov and P. V. Churayev p 34–37 refs
6. ZONE PURIFICATION OF NIOBIUM BY THE ELECTRIC ARC METHOD A. I. Yevstyukhin, V. V. Nikishanov, and I. V. Milov p 38–49 refs
7. INFLUENCE OF A PLASTIC SHELL AND DIE ANGLE ON THE OUTFLOW DURING THE EXTRUSION OF HEAT-RESISTANT ALLOYS L. N. Moguchiy p 50–60 refs
8. METALLURGICAL WAYS OF PREVENTING HOT CRACKS DURING AUTOMATIC WELDING UNDER FLUX OF HEAT-RESISTANT NICKEL ALLOYS M. Kh. Shorshorov and Yu. V. Sokolov p 61–70 refs
9. ON ALLOYING WELD METAL WITH MOLYBDENUM DURING ARC WELDING OF HEAT-RESISTANT ALLOYS ON A NICKEL BASE A. A. Yerokhin, O. M. Kuznetsov, and A. N. Bykov p 71–78 refs
10. POSSIBILITY OF CONTROL OF THE DISTRIBUTION OF IRREGULARITIES OF THE CRYSTAL LATTICE IN CAST HIGHLY ALLOYED ALLOYS B. A. Movchan and I. Ya. Dzykovich p 79–87 refs

N64-26123 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE ROLE OF BACTERIA IN ELECTROCHEMICAL CORROSION OF STEEL IN SEA WATER
L. A. Rozenberg 18 Jun. 1964 14 p refs Transl. into ENGLISH from Mikrobiologiya (Moscow), v. 32, no. 4, 1963 p 689–694
(FTD-TT-64-393/1+4; AD-602332)

Experiments conducted involved the effect of *Desulfovibrio desulfuricans* (sulfate-reducing bacteria) on 1X18H9T stainless steel and St-3 carbon steel, and the effect of saphrophytic bacteria—*Pseudomonas fluorescens, Bacillus mycoides*—and saphrophytic bacteria with rather low activity, on St-3 steel. The following are indicated by the results: (1) Bacteria play the role of biological depolarizers and activators in the electrochemical corrosion of steel in sea water. (2) The role of bacteria is very important in the initial period when they activate the metal surface and accelerate the formation of microgalvanic elements. (3) The weight loss of the stainless steel caused by the sulfate-reducing bacteria ranged from 0.048 to 0.135 g/m^2 for a period of 5 to 15 days, whereas the weight loss on St-3 steel reached 60 to 70 g/m^2 for a period of 30 to 40 days. (4) The weight loss due to the action of *Psuedomonas fluorescens* and *Bacillus mycoides* was much greater than that due to the sulfate-reducing bacteria. (5) Carbon steel weight losses from *Desulfovibrio desulfuricans* for a year can be 1.6% of the metal, and with certain saphrophytic bacteria, even 8% to 9%. (6) Only bacteria that are highly prolific, and produce substantial amounts of H_2S and NH_3, cause biological corrosion. I.v.L.

N64-26210 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
STRUCTURAL DIAGRAM OF VANADIUM–CERIUM SYSTEM
Ye. M. Savitskiy, V. V. Baron, and Yu. V. Yefimov 18 Feb. 1963 4 p refs Transl. into ENGLISH from Zh. Neorg. Khim. (USSR), v. 7, no. 3, 1962 p 701–703
(FTD-TT-62-1761/1; AD-400503)

A structural diagram of a vanadium–cerium system was constructed by using methods of macrostructural and microstructural, thermal, and X-ray analyses, as well as the microhardness method. Carbothermal vanadium and metallic cerium served as the basic materials. The fusions were prepared in an arc furnace. To attain uniformity in composition along the ingot, the alloys were subjected to fourfold resmelting. The annealing of alloys, containing up to 1 weight percentage of cerium, was done at 1,100° C for a period of 100 hrs, and alloys with greater cerium content at 750° C for a period of 200 to 250 hrs. R.T.K.

N64-26216 McDonnell Aircraft Corp., St. Louis, Mo.
DIMPLING OF 0.5 Zr-MOLYBDENUM ALLOY
Robert R. Wilcox 10 Jun. 1964 7 p
(Contract AF 33(657)-11215)
(A744; AD-441122)

Dimple test panels of 0.5 zirconium–molybdenum alloy, in 0.010- and 0.020-in. thicknesses, and fastened with 3/16-in. and 1/8-in. rivets were metallographically examined. Microscopic defects were found at the crest of the rivet dimples. With additional development and testing, the defects can be eliminated. D.E.W.

N64-26218 Battelle Memorial Inst., Columbus, Ohio
INVESTIGATION OF THE RELATIONSHIP OF TWINNING TO BRITTLE FRACTURE OF REFRACTORY METALS Technical Documentary Report, Jan. 1, 1963–Feb. 15, 1964
C. N. Reid, A. Gilbert, and G. T. Hahn Wright-Patterson AFB, Ohio, AF Mater. Lab., May 1964 63 p refs
(Contract AF 33(657)-7376)
(ASD-TDR-63-360, Pt. II; AD-602081)

Tension, compression, and bend tests have been used to investigate brittle fracture in both single-crystal and polycrystalline molybdenum samples of three contrasting compositions. Although in compression, twins were observed frequently to be responsible for transcrystalline and intercrystalline crack nucleation, during tension or bend tests, no failures were observed whose initiation could be ascribed to twinning. Even in single crystals stressed along [001], the fractures were not twin induced. It is concluded that twins are just one of several heterogeneities competing in the formation of cracks and that in the material examined other heterogeneities were always dominant. Experiments were conducted on Mo-35Re in which the strain was recorded as a function of time during the formation of twinning bursts. The results indicate that twinning in this situation is essentially a sonic phenomenon. Dislocation arrangements were revealed in Fe-3Si by etch-pitting, and it was observed that the propensity for twinning under given

conditions was identical in both the presence and absence of a strongly polygonized substructure. Author

N64-26233 Union Carbide Corp., Lawrenceburg, Tenn. Advanced Materials Lab.
RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS, SUPPLEMENT TO VOLUME XIII: DEVELOPMENT OF A FINE-GRAIN ISOTROPIC GRAPHITE FOR STRUCTURAL AND SUBSTRATE APPLICATIONS Technical Report, Sep. 1962–May 1963
R. A. Howard and R. L. Racicot Wright-Patterson AFB, Ohio, AF Mater. Lab., May 1964 22 p refs
(Contract AF 33(616)-6915)
(WADD-TR-61-72, Vol. XIII, Suppl.; AD-602606)

This report covers the characterization of grade RVC graphite and describes process and blend variations that were studied in the fabrication of substrate-type graphite. Present trials show that a forming pressure of 900 lbs/in.^{2}, instead of the 1,000 lbs/in.^{2} as used previously, would increase the yield of grade RVC and not significantly change the properties of the material. Furthermore, these trials show that various other blends will also produce a substrate graphite suitable for silicon carbide coating. Author

N64-26255 Army Missile Command, Huntsville, Ala.
A COMPARISON OF THE TOUGHNESS CHARACTERISTICS OF D6 AIR AND VACUUM MELT MATERIAL
Richard C. Davis and William S. Crownover 26 Mar. 1964 39 p
(RK-TR-64-11; AD-439222)

An investigation was made into the relative toughness properties of D6 air melt and D6AC vacuum melt material. This was accomplished to determine which type of material would be better suited for use in the construction of solid propellant motor cases. Standard smooth tensile and notched tensile tests were performed on both materials over a range of thicknesses and temperatures. The smooth tensile test indicated very little difference between the D6 air and D6AC vacuum melt material. The notched tensile test, however, indicated that the D6AC vacuum melt material possesses much better toughness properties than does the D6 air melt material. Author

N64-26258 Joint Publications Research Service, Washington, D.C.
THEORETICAL BASES OF CHEMICAL HEAT TREATMENT OF STEEL
A. A. Popov 21 Jul. 1964 143 p refs Transl. into ENGLISH of a book Sverdlovsk, St. Sci. and Tech. Publ. House of Lit. on Ferrous and Nonferrous Met., 1962
(JPRS-25521; TT-64-31793)

The regularities of formation of diffusion layers appearing during different operations of chemical heat treatment are described. The peculiarities of the structure of the diffusion layer of pure iron appearing during diffusion by one element and during saturation of iron alloys by different elements are discussed. R.T.K.

N64-26311 Eastman Kodak Co., Rochester, N.Y. Apparatus and Optical Div.
LONG WAVELENGTH INFRARED DOMES Interim Engineering Report, Mar. 10–June 10, 1964
Donald W. Roy Jun. 1964 52 p refs
(Contract AF 33(615)-1512)
(IER-1; AD-442937)

Major emphasis was placed on a better understanding of grain growth and control thereof. Problems and experiments related to improving both the raw ZnSe powder and the hot-pressed product are reported. Improved low reflection coatings are described, and future experiments designed to increase durability are discussed. Author

N64-26400 Joint Publications Research Service, Washington, D.C.
PREPARATION AND PROPERTIES OF SOME RARE-EARTH TITANATES
Chang Hui-Min *In its* Transl. on Communist China's Sci. and Technol., no. 98 21 Jul. 1964 p 5–12 refs (See N64-26398 18-07) OTS: $0.50

The magnetic susceptibility, electrical resistance, thermoelectric potential, and the dielectric constant of five rare earth titanates were determined. The method of specimen preparation and the values of the properties listed are presented. R.T.K.

N64-26420 Genoa U. (Italy)
ON THE BEHAVIOR OF TETRA- AND DIVALENT RARE EARTHS IN METALLIC COMPOUNDS Final Technical Report, 1 Apr. 1963–1 Apr. 1964
Aldo Iandelli [1964] 8 p
(Contract DA-91-591-EUC-2854)
(AD-439982)

The known intermetallic compounds formed from Cerium with Cu, Ag, Au, Zn, Cd, Hg, Al, Ga, In, Tl, Si, Ge, Sn, Pb, Sb, and Bi were studied magnetically, and a certain number of intermetallic compounds of Eu and Yb were studied structurally and magnetically. The composition of the compounds was checked by chemical analysis, and their homogeneity, when possible, was checked micrographically. The results are presented in tabular form. R.T.K.

N64-26463 Bureau of Mines, Boulder City, Nev. Boulder City Metallurgy Research Lab.
ELECTROREFINING BERYLLIUM. OPERATION OF A PROTOTYPE CELL
Morton Min Wong and J. E. Klosterman 1964 20 p refs
(BM-RI-6489)

Scrap beryllium chips (nominally 96% to 97% Be) were electrorefined in a prototype cell with 408 lb of electrolyte composed of 52.4 mole-percent LiCl, 36.3 mole-percent KCl, and 11.3 mole-percent $BeCl_2$. The cell temperature was 500° C. In a typical 10 3/4-hour deposition cycle, 0.415-lb of metal was produced; the metal contained impurities in parts per million as follows: C, 700; O, 610; Al, 34; Ca, 32; Cu, 20; Fe, 25; Mg, 9; and Mn, 23. Operation of the prototype cell for 2 years demonstrated that adapting the electrorefining process to an enlarged scale of operation presented few difficulties in mechanical functions, maintenance of optimum operating conditions, and control of product purity. After the spent anode feed was leached in a 5% nitric acid solution and the fine-sized particles were removed, it was recycled in some tests. The metal produced was somewhat higher in impurities than metal from the fresh scrap chips. Author

N64-26470* Hydronautics, Inc., Laurel, Md.
CAVITATION DAMAGE IN LIQUID SODIUM
H. S. Preiser, A. Thiruvengadam, and C. E. Couchman, III 1 Apr. 1964 89 p refs
(Contract NASr-105)
(NASA-CR-54071; TR-235-1) OTS: $8.10 ph

Suitable test facilities and techniques to conduct investigations of high-temperature liquid metals were developed. The considerations that governed the selection and development of a suitable laboratory facility are discussed. The operational experience gained from using such a facility is presented. Based on this experience, an improved facility was developed for testing refractory metals at temperatures up to 1,500° F in liquid sodium. The high-frequency fatigue-testing techniques developed for these investigations are described. Experiments designed to standardize magnetostriction test parameters are included along with a description of the components of the magnetostriction apparatus. An analysis was made to correlate the cavitation damage resistance of several metals in liquid sodium with their mechanical properties. The intensity of cavitation damage in impure liquid sodium at 400° F was estimated from these data. Author

N64-26471 Aeronautical Research Labs., Melbourne (Australia) Australian Defence Scientific Service
STRESS LEVEL AT THE CRACK FRONT IN UNNOTCHED ROTATING CANTILEVER FATIGUE SPECIMENS
J. M. Finney Sep. 1963 13 p refs
(ARL/SM-283)

An analysis was made of the change in nominal stress level accompanying the propagation of a fatigue crack through a rotating cantilever specimen. The nominal tension stress level at the crack front, assumed to be a chord, initially decreases but then rapidly increases with the propagation of the crack. On the basis of this analysis a qualitative explanation is advanced for the higher fatigue properties obtained by rotating cantilever testing as compared with axial load fatigue testing. Unusual fatigue cracking behavior of unnotched D.T.D. 683/3 aluminum alloy specimens in which angular cracking was preceded by normal transverse cracking to a depth that was related to the initial nominal stress level was also considered. The analysis showed, however, that there is no simple stress explanation for such behavior. Author

N64-26482 Bureau of Mines, Albany, Ore. Albany Metallurgy Research Center
QUARTERLY METALLURGICAL PROGRESS REPORT NUMBER 23, APRIL 1 THROUGH JUNE 30, 1964
A. H. Roberson [1964] 51 p refs
(Contract AT(11-1)-599)
(USBM-RC-1122) OTS: $1.25

Work in the following areas is summarized: (1) rare-earth alloys development—determination of selected properties of iron–chromium–gadolinium alloys; (2) hafnium carbide—determination of physical properties; (3) thorium alloy systems—determination of the three-phase diagrams for thorium with praseodymium, neodymium, and holmium; (4) cold-mold induction melting—preliminary designs for induction melting reactive metals in a cold-mold crucible; (5) investigation of the system uranium carbide–uranium—nitride–uranium oxide—examination of compositions of the UC-UO and UN-UO binary systems; (6) thermodynamics of cold-mold arc melting—experiments with larger scale (8-inch-diameter) crucibles and determination of the thermal resistance of the interface between the ingot and crucible wall; and (7) tungsten–rhenium tubing development—preparation of sintered sleeves. P.V.E.

N64-26504 Climax Molybdenum Co. of Michigan, Detroit Research Lab.
THE DEVELOPMENT AND EVALUATION OF TUNGSTEN-BASE ALLOYS Progress Report, 10 Jan.–10 Apr. 1964
M. Semchyshen, Robert Q. Barr, and Eric Kains [1964] 11 p
(Contract NOw-64-0057-c)
(AD-600086)

Tungsten-base alloys were prepared by the vacuum-arc-casting process. One blank from each ingot was subjected to the extrusion process. Wrought bar stock was obtained from ingots containing 0.5% Zr and 0.5% Hf, whereas blanks prepared from the other two heats stalled the extrusion press. The recrystallization behavior of the wrought bar stock is now being studied, and preparation of tensile test specimens from the successfully extruded bars is in progress. Author

N64-26512 Boeing Scientific Research Labs., Seattle, Wash. Solid State Physics Lab.
THERMAL CONDUCTIVITY OF COPPER-NICKEL ALLOYS AT 4.2° K
Joachim C. Erdmann and James A. Jahoda Apr. 1964 25 p refs
(DI-82-0333; AD-600457)

The lattice thermal conductivity n_g of the complete Cu-Ni alloy series at 4.2° K was derived from the measurement of the total thermal conductivity and the electrical residual resistivity of annealed specimens. There was an n_g decrease in the copper-rich alloys when the nickel content was increased. For most of the composition range, however, n_g is proportional to the electrical residual resistivity. Thus, a minimum of n_g vs composition was observed at Cu 92–Ni 08, and also a maximum at approximately Cu 55–Ni 45. The result is consistent with current theories of Klemens and Pippard. For the most nickel-rich alloy (Cu 02–Ni 98) indications of additional phonon scattering processes, perhaps by spin disorder, were found. The influence of plastic deformation on n_g was measured and is briefly discussed. Author

N64-26527 Thompson Ramo Wooldridge, Inc., Cleveland, Ohio TRW Electromechanical Div.
DESIGN DATA STUDY FOR COATED COLUMBIUM ALLOYS Final Summary Technical Report, 1 Mar. 1963–1 Mar. 1964
D. B. Warmuth 1 Apr. 1964 208 p refs
(Contract NOw 63-0471c)
(ER-5885; AD-600391)

Design data properties were determined for four protective coating columbium alloy systems involving oxidation protective coatings on B-66 and D-43 columbium alloys up to 2,600° F. Prior to the design data study, preliminary oxidation (low pressure and one atmosphere), bend and tensile tests were conducted on B-66 and D-43 alloys using two different Pfaudler coatings and the Cr-Ti-Si coating. Based on these evaluation tests the Pfaudler single-cycle silicide coating and the Cr-Ti-Si coating were selected for the mechanical properties evaluation. The following design properties were determined for the four coating-base metal systems: cyclic oxidation protective life, tensile properties of uncoated sheet in vacuum and coated sheet in air, creep properties of coated sheet in air, and coating deformation tolerance. In addition, a limited evaluation of the ballistic impact resistance of the coatings at room temperature and the tensile properties of coated joints was conducted. Author

N64-26534 General Electric Co., Cincinnati, Ohio Nuclear Materials and Propulsion Operation
HIGH-TEMPERATURE MATERIALS PROGRAM, PART A Progress Report, 15 Apr.–15 Jun. 1964
31 Jul. 1964 56 p
(Contract AT(40-1)-2847)
(GEMP-37A) OTS: $1.25

Fabrication and alloy-development studies on W-25Re, and W-Re-Mo alloys were continued; a marked improvement in the room-temperature ductility of W-25Re alloy was obtained. Creep–rupture tests at temperatures from 1,600° C to 2,600° C were conducted on W, Re, W-25Re, and Ta-10W specimens for comparison of strength. In order to determine the effect of radiation on the time-, temperature-, and stress-dependent properties, creep–rupture tests and studies of resistivity and microhardness were conducted on irradiated tungsten rod and sheet material. D.S.G.

N64-26543* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MECHANICAL PROPERTIES OF ECHO II LAMINATE
Howard L. Price and George F. Pezdirtz Washington, NASA, Aug. 1964 40 p refs
(NASA-TN-D-2367) OTS: $1.00

Mechanical properties are presented of the aluminum-poly[ethylene terephthalate]-aluminum laminate used to fabricate the Echo II passive communications satellite, and of the aluminum foil and poly[ethylene terephthalate] film that constitute the laminate. Tensile strength, Young's modulus, and elongation of 1/2-in.-wide samples were obtained for strain rates from 0.02 in./in. per minute to 4 in./in. per minute. Tensile stress relaxation of the laminate was determined for times up to 1,000 minutes. The flexural stiffnesses of the laminate, the aluminum foil, and the poly[ethylene terephthalate] film were measured by the heavy elastica method. The effects of fabrication and handling loads on the tensile strength, Young's modulus, elongation, and flexural stiffness of the laminate were examined. Author

N64-26614 Union Carbide Corp., Parma, Ohio Carbon Products Division Res. Lab.
HIGH TEMPERATURE RADIATION DAMAGE TO GRAPHITE. PART 1: PREPARATION OF GRAPHITES FOR IRRADIATION Summary Report, Apr. 1, 1960–Jun. 30, 1962
J. T. Meers and J. F. Doar Richland, Wash., Hanford Atomic Products Operation, 15 Apr. 1964 70 p refs
(Contract AF(45-1)-1603)
(HW-80752) OTS: $1.75

The graphites selected and prepared for irradiation tests are described, and the method of sample preparation is discussed. All preirradiation test data are tabulated by sample set. This includes purity, electrical and thermal conductivity, coefficient of thermal expansion, lattice spacings, density, and the sonic moduli. Author

N64-26616 Los Alamos Scientific Lab., N. Mex.
THE GRAVIMETRIC DETERMINATION OF RHODIUM IN URANIUM-RHODIUM ALLOYS
Ross D. Gardner and William H. Ashley 20 Jul. 1964 12 p refs
(Contract W-7405-ENG-36)
(LA-3097) OTS: $0.50

A gravimetric method in which rhodium is reduced to the metallic state by magnesium was modified and applied to the determination of rhodium in uranium–rhodium alloys. The precipitate of rhodium metal is placed in a porcelain boat that is transferred to a standard quartz combustion tube, where the rhodium is heated in a stream of hydrogen at approximately 1,000° C. The analysis of 58 known solutions simulating uranium–rhodium alloys containing from 0.5% to 10% rhodium showed an average recovery of 100.05% with a relative standard deviation of 0.7% for a single value. Author

N64-26618 Stanford U., Calif.
INFLUENCE OF LONG-RANGE ORDER ON SOME MECHANICAL PROPERTIES OF 2V PERMENDUR
John A. Hren and Oleg D. Sherby (Cambridge U.) 1 Dec. 1963 19 p refs
(DMS-63-23)

The influence of long-range order on the elastic, anelastic, and plastic properties over a broad temperature range was investigated in the BCC alloy 2V Permendur (49% Fe–49% Co-2% V). The dynamic modulus measurements indicate two second-order phase changes occurring with increasing temperature. A large drop in modulus is observed between 550° and 740° C, which is attributed to the gradual disappearance of long-range order. A second drop in modulus between 780° and 850° C is attributed to a gradual loss of ferromagnetism; the drop in modulus in this range was found to be slightly frequency dependent, suggesting that grain boundary relaxation or Zener relaxation may have also contributed to the change in modulus. Above 900° C the modulus begins to rise, and this is attributed to a gradual transformation of the body-centered-cubic alpha phase into the face-centered-cubic gamma phase. The steady-state creep rate between 650° and 800° C shows a sharp change in the slope at the order–disorder temperature, 740° C. The activation energy in the disordered region is constant and is about 70 k cal/mole when corrected for the temperature variation of the elastic modulus. Below 740° C the activation energy calculations are not meaningful since the state of order is different at each temperature. A very high resistance to creep in the temperature range 600° to 800° C is exhibited by 2V Permendur. It is believed that the high strength of this material in this temperature range is due to its low atomic mobility, associated with its ordered structure and with its ferromagnetic state. Author

N64-26623 University Coll., Cardiff (Gt. Brit.)
INTERNAL FRICTION OF MARTENSITE
R. Rawlings and J. Mc Grath 29 Feb. 1964 54 p refs
(Contract DA-91-591-EUC-2834)
(ATR-1; AD-600848)

A survey of the literature dealing with the internal friction of martensite was made. The internal friction peak at 250° to 270° C, generally accepted as being due to stress-induced movement of dislocations associated with carbon atoms or carbide particles, increases in height with carbon content. The rate of increase with carbon content decreases when the percentage of carbon is more than 0.6. Possible reasons for this are discussed. These include the increased proportion of austenite, the faster rate of tempering during the test, and the possibility of saturation of the dislocations with the higher carbon contents. I.v.L.

N64-26627 Aeronautical Research Labs., Melbourne (Australia)
THE FATIGUE PROPERTIES OF TWO CASTING ALUMINIUM ALLOYS CONTAINING MICROPOROSITY
J. M. Finney Sep. 1963 15 p refs
(ARL/SM-282)

The unnotched and notched (K_t = 5.0) rotating cantilever fatigue behavior of two permanent mold casting aluminum alloys, A143-T5 and SAE 300-T5, was investigated. The two alloys exhibited similar fatigue strengths, but they both contained considerable microporosity resulting in a general reduction of fatigue and tensile properties. A reasonable guide to the influence of microporosity on unnotched fatigue strength is the percentage reduction in ultimate tensile strength. Author

N64-26669 Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
GUIDING PRINCIPLES FOR LOWERING THE DUCTILE-TO-BRITTLE TRANSITION TEMPERATURE IN THE BODY-CENTERED-CUBIC METALS
Hans Conrad 10 Dec. 1963 30 p refs
(ATN-64(9236)-4; AD-437596)

Yielding, flow, and fracture of body-centered-cubic metals are briefly reviewed to ascertain the guiding principles for lowering the ductile-to-brittle transition temperature, T_c. It is concluded that the major methods for lowering T_c in polycrystals are ultrahigh purification, use of scavengers to remove interstitials, prestraining, decreasing the grain size, and introducing a dispersion of hard second-phase particles. Experimental and theoretical support exists for each of these methods. Author

N64-26692 Atomics International, Canoga Park, Calif.
SNAP TECHNOLOGY HANDBOOK. VOLUME I: LIQUID METALS
G. F. Burdi 30 May 1964 152 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-8617, Vol. I)

The work contains important excerpts from commonly used references along with recent developments, arranged from the convenience of the design engineer. Data selected for presentation have passed the test of being in reasonable agreement with the majority of published work; some older data not well substantiated by recent experiments have not been included. The liquid metals considered to be the most useful for present and future applications are mercury, sodium, sodium-potassium, potassium, rubidium, and lithium. As additional information becomes available, periodic revisions will be incorporated in this handbook. Author

N64-26703 Naval Research Lab., Washington, D.C. Metallurgy Div.
NOTCH TOUGHNESS OF THREE LOW-ALLOY STEELS AT ELEVATED TEMPERATURES
George Sandoz Apr. 1964 11 p ref
(NRL-1523; AD-600188)

The experimental data indicate that the candidate steel HY-80 might justify consideration for high-temperature service where there is concern about a rapidly running low-energy shear fracture initiated by a large flaw. The Charpy V-notch energy values of steel "A," however, are probably too low to assure immunity from catastrophic low-energy shear fractures during service within the temperature range studied (from 100° to 1,000° F). The Charpy V-notch energy of the steel from the USS Saratoga piping ranges between 60 and 100 ft lb at temperatures between 500° and 900° F. This energy is adequate to assure that catastrophic fractures would not be generated in the piping during cycle-load service at temperatures between 500° and 950° F, even in the presence of large flaws. R.T.K.

N64-26714 Lockheed Missiles and Space Co., Sunnyvale, Calif.
THE GROWTH OF METAL AND METALLIC OXIDE WHISKERS: AN ANNOTATED BIBLIOGRAPHY
Charlie M. Pierce, comp. May 1964 54 p refs
(SB-63-68; Rept.-4-11-63-7)

This publication consists of references primarily involved with the growth mechanism of whiskers, the metals most susceptible to whisker growth, optimum conditions for growth, and the rates of whisker growth. Most of the references were published after 1953. The references are alphabetically arranged according to the first author. Personal author and subject indexes are included. Author

N64-26723 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
11 Mar. 1963 20 p refs Transl. into ENGLISH from Metalloved. i Term. Obrabotka Metal. (Moscow), no. 6, 1962 p 2–5, 14–17
(FTD-TT-63-2/1+2+4; AD299654)

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N64-26734 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
POWDER METALLURGY Selected Articles
5 Mar. 1963 40 p refs Transl. into ENGLISH from Poroshkovaya Met., Akad. Nauk Ukr. SSR (Kiev), no. 4, 1961 p63, 86–102
(FTD-TT-62-1473/1+2+4; AD-299652)

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3. ON THERMAL FATIGUE OF METAL-CERAMIC MATERIALS G. N. Tret'yachenko p 25–30 refs
4. PURIFICATION OF MOLTEN SODIUM BY CERMET FILTERS I. M. Fedorchenko, N. A. Filatova et al p 31–37 refs

N64-26743 Hanford Atomic Products Operation, Richland, Wash. Reactor and Fuels Lab.
EFFECTS OF NEUTRON IRRADIATION ON THE FLOW AND FRACTURE BEHAVIOR OF ZIRCALOY-2
A. L. Bement, J. C. Tobin, and R. G. Hoagland 1 Apr. 1964 32 p refs
(Contract AT(45-1)-1350)
(HW-82102) OTS: $0.75

This is a summary of the more important findings on the effects of fast-neutron exposures over the range 10^{19} to 10^{21} neutrons/cm^2. Strong crystalline textures were developed in Zircaloy-2 by cold rolling and were relatively stable with respect to subsequent annealing process in the alpha phase. Plastic deformation was greatly influenced by preferred orientation due to the restriction and specificity of slip systems. Anisotropy in yield strength was constant with neutron irradiation. Irradiations at hot-water temperatures to high neutron doses resulted in greater accumulation of damage than irradiations at lower temperatures. The increase in yield strength with irradiation can be related to integrated neutron flux by an inverse exponential function, which in turn can be used to determine the limiting strength at saturation. Ductile fracture processes in Zircaloy-2 are sensitive to testing direction before and after irradiation. Notched specimens tested in slow bending exhibited a sharp ductile-to-brittle transition below room temperature. Hydrogen was absorbed during the in-reactor hot-water exposure of Zircaloy-2 in quantities ranging to about 175 ppm. I.v.L.

N64-26790 Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
INFLUENCE OF SEVERAL METALLURGICAL VARIABLES ON THE TENSILE PROPERTIES OF HASTELLOY N
H. E. Mc Coy Aug. 1964 65 p refs
(Contract W-7405-ENG-26)
(ORNL-3661) OTS: $1.75

The tensile properties of Hastelloy N were evaluated after various heat treatments. One vacuum-melted and four air-melted heats were studied. The vacuum-melted material exhibited good ductility after all heat treatments. Annealing the air-melted material to temperatures in excess of 2,150° F brought about significant reductions in the minimum fracture strain exhibited by the alloy. Holding at temperatures of about 1,600° F for an extended period recovered the fracture ductility. Aging material in the 1,100° to 1,200° F range that was previously annealed at 2,150° F brought about a significant reduction in the ductility. These changes in ductility occurred with very small changes in tensile strength. These effects can be explained in terms of the formation of a brittle grain boundary layer along which a crack can propagate easily at elevated temperatures. Interrupting the continuity of this layer by over-aging or cold working recovers good fracture ductility. The formation of this layer is associated with the presence of trace alloying elements. Author

N64-26799 Atomics International, Canoga Park, Calif.
BERYLLIUM OXIDATION RESEARCH RELATIVE TO THE SNAP 8 REACTOR
G. Ervin, Jr. and T. L. Mackay 24 Jul. 1964 48 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9672) OTS: $1.00

Corrosion of beryllium by high-temperature air is a potential problem in SNAP 8 ground test reactors. Presented here are results of a research study in which oxidation of beryllium, in the temperature range of 500° to 900° C, proceeds very slowly during an initial protective period, but catastrophically during a subsequent accelerating period. Analysis of oxidation kinetics during the protective period showed a parabolic rate, and a decrease in rate with pressure, proportional to the 1/5th power of the oxygen pressure, in agreement with the theory that oxidation rate is controlled by diffusion of beryllium ion vacancies in the BeO film lattice. Author

N64-26811 IIT Research Inst., Chicago, Ill.
NOTE ON THE DISTRIBUTION COEFFICIENT OF SILICON IN ALUMINUM
Paul Gordon Jul. 1964 4 p
(Grant DA-ARO(D)-31-124-G95)
(TR-7; AD-443932)

Mass spectrographic analyses of three bars of zone-refined aluminum showed that copper is efficiently removed by the zone refining, but silicon is not. Data for the silicon and copper contents of the three refined bars are given in tabular form. For each bar, the silicon and copper contents were comparable in the starting material. In the AlAG refined material, for example, the copper content was reduced from 1 to 2 ppm to 0.04 ppm, whereas the silicon decreased from 1 to 2 ppm only to 0.77 ppm. It seems likely, therefore that k for silicon in aluminum is not much below unity. This also implies that the liquidus and/or solidus curves are very probably appreciably curved on the aluminum-rich side of the diagram. I.v.L.

N64-26843 Du Pont De Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.
DISSOLUTION OF ZIRCONIUM ALLOY FUELS IN 309SCb STAINLESS STEEL VESSELS
Edward S. Occhipinti and J. Harding Owen Jun. 1964 25 p
(Contract AT(07-2)-0)
(DP-872) OTS: $0.50

Tests were made to define the conditions for dissolving zirconium and zirconium–uranium alloys in 309SCb stainless-steel vessels without excessively corroding the vessels. The optimum dissolvent found was an agitated solution of 1M HNO_3 at 70° C with a small stream of concentrated hydrofluoric acid injected continuously near the agitator. Under these conditions, 10 tons of zirconium alloy can be dissolved in successive charges over a period of 2 to 3 weeks with less than one mil of vessel corrosion. Author

N64-26844 Bureau of Mines, Reno, Nev. Reno Metallurgy Research Center
ELECTRICAL CONDUCTIVITY AND DENSITY OF MOLTEN SYSTEMS OF URANIUM TETRAFLUORIDE AND THORIUM FLUORIDE WITH ALKALI FLUORIDES
Ernest A. Brown and Bernard Porter 1964 21 p refs
(BM-RO-6500)

Electrical conductivities and densities of the LiF-UF_4, LiF-ThF_4, NaF-ClF_4, and NaF-ThF_4 systems were measured as functions of composition and temperature. The specific conductance and density varied linearly with temperature. Molar and equivalent volumes, as well as heats of activation for conductance, were calculated from the experimental data. At 1,000° C, the molar volumes ranged from 16 to 40 cubic centimeters per mole and the specific conductance ranged from 9.8 to 2.5 per ohm-centimeter as the actinide metal fluoride concentration changed from 0 to 60 mole-percent. Heats of activation for conductance were 3 to 7 kcal per mole. The data are interpreted on the basis of a semilattice model for the melts. Author

N64-26864 Midwest Research Inst., Kansas City, Mo.
RESEARCH ON THE MECHANISMS OF FATIGUE IN ULTRA SMALL SPECIMENS Quarterly Progress Report, 1 Dec. 1963–31 Mar. 1964
J. C. Grosskreutz 14 Apr. 1964 25 p refs
(Contract AF 33(657)-10883)
(QPR-2; AD-603522)

Two phases of the current work are described. The first phase, now completed, is concerned with possible dislocation rearrangement in fatigue-hardened aluminum during preparation of samples for transmission electron microscopy. The second phase deals with a theory of fatigue crack propagation. A method of thinning is described in which a thin (600 A) anodic layer is kept intact on the surface of an aluminum foil during thinning. Such an arrangement suppresses both the escape of dislocations from the surface and their rearrangement within the foil. When rearrangement does occur, slip traces left at the foil-oxide interface record the manner in which this occurs. Rearrangement in fatigue-hardened polycrystalline aluminum, which contains a well-developed cell structure, is confined to about 15% of the cells and consists of dislocation motion from one boundary to another across the cell. No measurements were possible to determine actual dislocation loss during thinning, but it is suggested that a previous measurement by Ham may be in error due to pinning of dislocations in the interior of cells during rearrangement. Author

N64-26946 Rocketdyne, Canoga Park, Calif.
STRENGTHENING IRON-BASE ALLOYS BY SHOCK WAVES Quarterly Progress Report, 16 Jan.–15 Apr. 1964
B. G. Koepke and R. P. Jewett 30 May 1964 78 p refs
(Contract AF 33(657)-11250)
(R-5413-3; AD-600579)

Shock loading of all materials at 157 and 270 kilobars was completed. Hardness measurements were completed on all materials, including solution-treated, shocked, and aged A-286 steel. Aging of shock-loaded A-286 steel resulted in higher maximum aged hardness, and peak hardness was reached in shorter times. Transmission microscopy of the plain carbon and alloy structural steels was completed. Results showed that the amount of strengthening was associated with a dislocation density increase in the free ferrite. The relative amount of strengthening was a function of the amount of free ferrite present. Results on 302 stainless steel indicated the presence of epsilon (hcp) martensite on $\{111\}_\gamma$ planes and transformation of some of the austenite to alpha martensite. Author

N64-26948 Union Carbide Corp., Lawrenceburg, Tenn. Advanced Materials Lab.
RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XXVI: PHYSICAL PROPERTIES OF SOME NEWLY DEVELOPED GRAPHITE GRADES Technical Documentary Report, 1 May 1960–30 Apr. 1963
R. B. Dull Wright-Patterson AFB, Ohio, AF Mater. Lab., May 1964 470 p refs
(Contract AF 33(616)-6915)
(WADD-TR-61-72, Vol. XXVI; AD-602607)

This report presents the physical properties that were measured on the graphites developed and/or evaluated under this program. Methods of and equipment for making these measurements are described. The physical properties are reported for 17 newly developed graphite grades, which include 6 high-density, recrystallized graphites designated as ZT grades; 6 graphites in which the fillers are shredded or woven carbonized cloths designated as PT grades; and 5 pressure-cured and/or impregnated grades designated as RVA, RVC, RVD, CFZ, and CFW. Similar properties of ATJ graphite are presented as a basis for comparing the newly developed grades with a well established, premium grade of graphite. Author

19 MATERIALS, NONMETALLIC

Includes mechanical and physical properties of nonmetals (e.g., plastics). *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 18 Materials, Metallic; 33 Stresses and Loads; and 34 Structural Design.

N64-25837 General Electric Co., Schenectady, N.Y. Research Lab.
GAS PERMEATION THROUGH FUSED SILICA CAPSULES DURING HIGH-TEMPERATURE HEAT TREATMENTS
F. J. Norton and A. U. Seybolt Nov. 1963 8 p refs
(Rept.-63-RL-3515X)

Data for oxygen permeation through vitreous silica at 1,000° C are applied to a specific case. This application illustrates the difficulties in firing metallurgical specimens in silica tubes in air, where it is necessary to keep oxygen partial pressure low. Author

N64-25896 Douglas Aircraft Co., Inc., Long Beach, Calif.
SONIC FATIGUE DAMPING MATERIAL Final Report
P. R. Mc Gowan and J. M. Snider Sep. 1963 78 p refs
(Contract NOw-62-1071-C)
(LB-31451; AD-600170)

Four basic material compositions were used in studies of vibration damping and adhesive stress reduction for alleviation of sonic fatigue. Variations of these four compositions were prepared by changing the ratios of the basic components and by the addition of different percentages of glass or aluminum flake pigments. Test panels simulating aircraft structures were exposed to an overall sound level of 158 db in a random noise generator. Best protection against sonic fatigue was obtained by adhesive damping in areas of structural attachment. Measurements of stress reduction in adhesion panels instrumented with a strain gage showed good results with materials compounded with glass or aluminum flake pigments. A polysulfide dispersion and a nylon–epoxy composition were used as the base compounds in these tests. Vibration damping tests were conducted with coated vibration strips with strain gages attached. An attempt was made to correlate dynamic physical properties of the damping compounds, such as creep and recovery, with damping efficiency. Loss moduli values were low for all materials tested but a very significant increase was obtained by the addition of flake pigments. Author

N64-25900 Tem-Press Research, Inc., State College, Pa.
STUDIES RELATED TO THE CRYSTALLIZATION OF GLASSES: CONTROLLED PHASE SEPARATION DUE TO METASTABLE LIQUID IMMISCIBILITY IN SIMPLE SILICATE SYSTEMS
Bert Phillips and Rustum Roy (Pennsylvania State U.) 15 May 1964 21 p refs
(Contract Nonr-4089(00))
(TR-2; AD-600744)

The tendency to separate metastably, compositions close to but outside of stable liquid immiscibility regions was studied for various simple silicate systems such as $BaO\text{-}B_2O_3\text{-}SiO_2$, $PbO\text{-}B_2O_3\text{-}SiO_2$, $CaO\text{-}MgO\text{-}SiO_2$, and $CaO\text{-}TiO_2\text{-}SiO_2$. Another system, namely $Na_2O\text{-}B_2O_3\text{-}SiO_2$, where stable liquid immiscibility does not occur, but from which compositions are known to yield metastable separation, was also studied as a reference. Small glass specimens were heat treated over a range of temperatures to determine the temperature range of metastable separation. Rods of similar composition were drawn and heat treated in the determined temperature range to develop phase separation. The products were studied by light and electron micrography and by X-ray diffraction. Author

N64-25947 Battelle Memorial Inst., Columbus, Ohio
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING MAY, 1964
Russell W. Dayton and Ronald F. Dickerson 1 Jun. 1964 49 p
(Contract W-7405-ENG-92)
(BMI-1672) OTS: $1.25

The current status of the following areas is discussed: (1) reactor materials and components; (2) fuel studies; (3) general fuel-element development; (4) radioisotope and radiation applications; (5) coated-particle fuel materials; (6) corrosion studies of the fluoride-volatility process; (7) fission-product deposition studies; (8) the gas-cooled reactor program; and (9) the long-term creep–rupture program on sintered aluminum powder alloys; (10) the mechanical properties of zirconium alloys; and (11) the development of small radioisotopic power sources. I.v.L.

N64-25964 Hanford Atomic Products Operation, Richland, Wash. Reactor and Fuels Lab.
FRACTURE STRESSES OF UO_2-TUNGSTEN CERMETS EVALUATED BY THE DIAMETRAL TENSILE TEST Interim Report 1
E. A. Snajdr Jan. 1964 41 p refs
(Contract AT(45-1)-1350)
(HW-79676; TID-4500) OTS: $1.00

Pneumatically impacted UO_2-tungsten cermets in a composition range from pure tungsten (particle size of 5μ) to tungsten-50 vol % UO_2 (particles size of 44μ to 75μ were tested by the diametral tensile test at room temperature. The tensile fracture stresses decreased from 22,000 to 14,000 psi as the composition varied from pure tungsten to tungsten-50 vol % UO_2. Results of the diametral tensile test are usually lower than the values of the direct pull tensile test and modulus of rupture test. The average fracture stress of 20 vol % UO_2 tungsten cermet was 45,690 psi by the modulus of rupture test and 18,400 by the diametral tensile test. Because of the preferential alignment of elongated UO_2 particles during pneumatic impaction, the tensile fracture stresses were orientation-dependent with respect to the pneumatic impaction direction. Author

N64-25984 Houghton (E.F.) and Co., Philadelphia, Pa.
DEVELOPMENT OF FIRE RESISTANT WATER BASED HYDRAULIC FLUIDS First Bimonthly Report
Philip Rakoff, G. John Colucci, and Robert K. Smith 25 May 1964 13 p
(Contract NObs-90269)
(AD-600568)

The main objective of this study is to impart fire resistance in both a finished lubricant and the nonaqueous residue. The targets include a flash point of greater than 450° F and an autogenous ignition temperature of at least 900° F. Several water-soluble esters were synthesized, which may be utilized as fire-resistant additives in hydraulic systems. In the preliminary blending project, various formulas were established that meet the viscosity requirements of the target fluid. R.T.K.

N64-25986 Houston Fearless Corp., Los Angeles, Calif. Westwood Div.
CONTRAST MODULATION TECHNIQUES FOR IMAGE ENHANCEMENT
J. Hannum, N. Taylor, J. Davis, and W. Birkner Wright-Patterson AFB, Ohio, AFSC, Mar. 1964 50 p
(Contract AF 33(657)-8443)
(AFSC-TDR-64-45; AD-600295)

This program was undertaken to find a better way to interpret information recorded on a silver–halide photographic emulsion. The information of major interest was that below the threshold of human vision, being obscured because of low density differences caused by improper exposure or other effects. The proposed program of research and development consisted of a study of enhancement techniques in general, a design study of the instrumentation techniques required to achieve the most promising enhancement principles, and the fabrication of the necessary laboratory apparatus to demonstrate these techniques. Author

N64-26035 Bureau of Mines, Pittsburgh, Pa. Explosives Research Center
HYDROGEN SAFETY Progress Report No. 2, 1 Apr.–30 Jun. 1964
M. G. Zabetakis, R. A. Van Meter, I. Liebman, and E. L. Litchfield Jul. 1964 14 p refs

This report reviews existing hydrogen safety practices in order to establish a partial set of acceptable standards as well as a list of areas in which additional information is needed to complete such a set. A hydrogen detector evaluation program and an experimental program on initiation of detonation in hydrogen–oxygen mixtures were started, and the results are presented. G.D.B.

N64-26036 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
FAOLITE FOR ANTI-CORROSION PROTECTION
L. Schwartz 27 Apr. 1964 12 p refs Transl. into ENGLISH from Revista de Chimie (Rumania), v. 13, no. 4, 1962 p 231-233
(FTD-TT-63-1169/1+2+3+4; AD-600811)

This paper describes the fabrication of faolite in Rumania. Efforts are currently being made to increase the technological state for processing and using the material. Research is being pursued for producing faolite with furanic resin. G.D.B.

N64-26061 Hercules Powder Co., Magna, Utah Chemical Propulsion Div.
AGING OF RACEWAY ADHESIVE Final Report
R. E. Schneider 20 May 1964 54 p
(Contract AF 04(694)-127)
(MTO-258-7; AD-600679)

The test was conducted to evaluate the effects of aging on the Armstrong A12T epoxy adhesive bonding system used on the raceway and case interface of the third-stage Minuteman motor. A modification of the ASTM cleavage test was conducted. Seventy-two cylindrical section raceway samples from 9 FSU motor cases were tested. The cases were selected from lots that represented the time interval from the earliest cases manufactured to the most recent available. The cases ranged from 282- to 1,210-days old. Sixteen additional new samples (prepared at the time of the test) were tested to provide a control basis for comparison. The results of a statistical analysis revealed no evidence of physical deterioration of Armstrong A12T epoxy adhesive as a result of aging. The variation in shear strength and hardness, and the ratio of cohesive to adhesive failure that resulted from this test were attributed entirely to the variation in mix ratio, thoroughness of mix, surface preparation, and method of application. Author

N64-26074* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
VISIBLE ABSORPTION SPECTRA OF CADMIUM IN CADMIUM HALIDES AND LEAD CHLORIDE AND IN LEAD BROMIDE
Jacob Greenberg Repr. from J. Chem. Phys., v. 40, no. 10, 15 May 1964 1 p refs
(NASA-RP-247)

Tables and graphs are presented showing the following: (1) visible absorption maxima for cadmium salts ($CdCl_2$, $CdBr_2$, CdI_2), lead salts ($PbCl_2$, $PbBr_2$), and metal mixtures (Cd-$CdBr_2$, Cd-$CdCl_2$, Cd-CdI_2, Pb-$PbCl_2$, Pb-$PbBr_2$); (2) visible absorption spectra of $PbCl_2$, $PbBr_2$, and Pb in $PbCl_2$, $PbBr_2$; and (3) visible absorption spectra of cadmium halides and cadmium in cadmium halides. P.V.E.

N64-26268 Alfred U., N.Y.
THE STRESS-STRAIN BEHAVIOR OF STRONTIUM ZIRCONATE Bimonthly Progress Report, 15 Jan.–15 Mar. 1964
J. E. Funk, J. Nemeth, and J. R. Tinklepaugh [1964] 10 p refs
(Contract NOw-64-0051-d)
(BMPR-3; AD-436324)

Success was achieved in sintering C. P. $SrZrO_3$. Mechanical grinding was necessary to facilitate sintering; the impurity pick-up is low enough not to be detectable. Small single crystals were grown from a salt flux by seeding with a few small grains of $SrZrO_3$. Author

N64-26272 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
INTERPRETATION OF ROOM TEMPERATURE MECHANICAL PROPERTIES TEST DATA FOR PYROLYTIC GRAPHITE
J. M. Berry and J. J. Gebhardt May 1964 41 p refs
(R64SD39)

This investigation of the mechanical behavior of pyrolytic graphite had two objectives: (1) to develop an understanding of the phenomena of failure and apply it to the interpretation of mechanical properties data, and (2) to explore techniques for increasing room-temperature strength. Pyrolytic graphite is both exceedingly anistropic and brittle. The conditions of deposition determine the degree of anisotropy, and this, in turn, has a marked effect on the relationships among specimen-test configuration, nominal strength, and fracture mode. Furthermore, the "notch sensitivity" is orientation dependent and, thus, related to the degree of anisotropy. The mechanical test results and studies of the fracture modes suggest that the results obtained by testing conventional laboratory specimens are not necessarily representative of those that would be obtained by testing free standing structures. Author

N64-26545 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
MATERIALS FOR LAMINATED PHOTOELASTIC MODELS [WERKSTOFFE FUER SPANNUNGSOPTISCHE MODELLE VON VERBUNDKONSTRUKTIONEN]
Max Kufner London, Min. of Aviation, May 1964 12 p refs
Transl. into ENGLISH from Z. Angew. Phys. (W. Berlin), v. 14, no. 7 p 444–448
(RAE-TRANS-1064)

The possibility of making photoelastic laminated models with the same ratio of moduli of elasticity as the prototype is investigated, and the variation of the modulus of elasticity of araldite by addition of resins is evaluated. Results are presented graphically, from which it is possible to select pairs of materials whose moduli of elasticity are in a given ratio. Author

N64-26591* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PERMEATION OF ADHESIVELY BONDED JOINTS BY GASEOUS AND LIQUID HYDROGEN
C. T. Egger, D. A. Nauman, T. J. Carter, and J. B. Gayle 19 Jun. 1964 39 p
(NASA-TM-X-53066) OTS: $3.60 ph

The permeabilities of selected adhesives to gaseous and liquid hydrogen were determined experimentally. Frequent rupture on exposure to liquid hydrogen suggests that for the nonfilleting adhesives bond integrity rather than permeability considerations will limit the utility of adhesive bonds for liquid hydrogen applications. Permeabilities for the filleting adhesives are several orders of magnitude higher and tend to preclude their use for such applications. Author

N64-26600* State U. of Iowa, Iowa City
SURVIVAL OF THIN FILMS IN SPACE
James A. Van Allen Jul. 1964 10 p refs
(Grant NsG-233-62)
(NASA-CR-58122; SUI-64-22) OTS: $1.10 ph

Many months of radiation observations with earth satellites and with interplanetary space-probe Mariner II were made using detectors whose sensitive volumes were directly exposed to outer space through thin films of mica or metal. Not one of these detectors has suffered a failure, such as would result from puncture of the film. Summary tables are presented for earth satellite exposures and for Mariner II exposures. The table for earth satellite exposures summarizes the integrated exposures in m^2 sec sterad. The effective exposures are obtained by multiplying the actual exposures by a factor, less than 1, estimated to correct for magnetic geometric shielding by the solid earth and its dense atmosphere. The sum of the effective unidirectional exposures is 230 m^2 sec sterad. The summary of Mariner II exposures gives the exposure time as 10.7×10^6 sec; the geometric factor as 0.2 cm^2 sterad; and the total unidirectional exposure as 214 m^2 sec sterad. I.v.L.

N64-26671 Aeronautical Systems Div., Wright-Patterson AFB, Ohio Air Force Materials Lab.
AN INDEX TO NON METALLICS R&D PROGRAMS OF TEN AEROSPACE COMPANIES Supplement I
George Young 9 May 1963 215 p refs
(ASRCE-TM-62-24, Suppl. 1; AD-437826)

This index (Appendix I) is a follow-on to the index presented in ASRCE TM-62-64. It covers 167 abstracts describing nonmetallics R&D programs being conducted by 10 aerospace companies. The abstracts (Appendix II) were assigned index numbers ranging from 236 to 402. All programs described are recent, and many are still in progress. Over 300 materials are reported. The index itself is made up of four sets of terms. The first set is strictly on materials, the second on properties, the third on processes, and the fourth set consists of miscellaneous terms such as antennas, O-rings, and space vehicles. I.v.L.

N64-26688 Southwest Research Inst., San Antonio, Tex.
A STUDY OF RAPID SOLIDIFICATION OF HYDROCARBON FUELS Monthly Progress Report, 1 Feb.–1 Mar. 1964
E. C. Martin 10 Mar. 1964 11 p
(Contract DA-44-177-TC-819(T))
(AD-439722)

The following are discussed: (1) polyureas as gelling agents; (2) the burning properties of various gels; and (3) gel rigidity. Tables are presented that contain the following information: (1) attempted gelation of JP-4 cyclohexylamine and various diisocyanates; (2) gelation of JP-4 using dodecenylaminoethyl ether and various diisocyanates; (3) gelation of JP-4 using oleyl isocyanate and various amines; (4) gelation of JP-4 using menthane diisocyanate and various amines; (5) burning characteristics of JP-4 gelled with various systems; and (6) penetrometer tests on various particulate gels. R.T.K.

N64-26690 Hanford Atomic Products Operation, Richland, Wash. Hanford Labs.
CERAMICS RESEARCH AND DEVELOPMENT OPERATION Quarterly Report, Jan.–Mar. 1964
[1964] 81 p refs
(Contract AT(45-1)-1350)
(HW-81600) OTS: $2.00

This report describes 41 research activities in the areas of ceramics research, fuels development, and fuels testing and analysis. I.v.L.

N64-26691 Rutgers U., University Park, N.J. School of Ceramics
ELASTIC MODULI AND TENSILE STRENGTH OF GLASSES AND OTHER CERAMIC MATERIALS Progress Report No. 4, 1 Jan.–31 Jun. 1964
George A. Chase [1964] 7 p Submitted for Publication
(PR-4)

Young's modulus of elasticity was calculated from the composition of a glass consisting of 80% SiO_2, 10% Na_2O, and 10% CaO. In this simple glass, only the Na_2O coefficient

is variable and, for this amount of SiO_2, it has a value of 1.4 kilobars per mole percent. The calculated modulus of elasticity E is then 80% SiO_2 × 7.3 = 584.0 + 10% Na_2O × 1.4 = 14.0 + 10% CaO × 12.6 = 126.0 = 724.0 kilobars. Experiments showed that glasses containing large amounts of TeO_2 give the lowest elastic moduli observed to date. Also, the anomalous elastic behavior of the alkaline earth oxides, including ZnO, is discussed, and some very preliminary explanations are suggested. I.v.L.

N64-26755 Picatinny Arsenal, Dover, N.J. Feltman Research Labs.
EFFECT OF SURFACE PREPARATION AND ELEVATED TEMPERATURE STORAGE ON ADHESIVE BONDS TO ALUMINUM
Raymond F. Wegman May 1964 25 p refs
(PA-TM-1255; AD-600033)

Two room-temperature-curing epoxy-type adhesives were used to bond aluminum to aluminum. Two chemical methods of treating aluminum were used. The effects of variations in test temperature, MIL-STD-304 conditioning, and elevated and room temperature storage for 1 year were evaluated. In all of the cases investigated, elevated temperature storage had no detrimental effect after 1 year. However, there was in all cases a decrease in tensile strength during the initial stages of heat storage and no substantial increase was noticed until after 6 months. The choice of surface treatment, which is dependent upon the adhesive selected, can result in a difference in bond strengths. In the case of the novolac-based epoxy, there was a substantial difference between the tensile strengths obtained using the two treatment methods. The liquid hydrochloric acid treatment was superior to the commercial paste treatment. In the case of the polyamide-epoxy, the results obtained were substantially the same regardless of the method selected. Author

N64-26823 Lockheed Missiles and Space Co., Sunnyvale, Calif.
ADHESIVES, SEALS, GASKETS, AND POLYMERIC MATERIALS FOR AEROSPACE APPLICATIONS: AN ANNOTATED BIBLIOGRAPHY
Helen M. Abbott, comp. Nov. 1963 202 p refs
(Contract AF 33(657)-10107)
(SB-63-77; Rept.-3-06-63-2; AD-443256)

This bibliography contains selected references to polymeric materials, seals, gaskets, adhesives, and sealants for use in aerospace applications. The environmental conditions that will affect materials in space are exposure to high vacuum, high and low temperature extremes, ultraviolet and high-energy radiation, as appropriate to the application of the material. References to tests conducted on elastomeric materials in contact with liquid rocket fuels and oxidizers are included under the area of chemical compatibility. These references were compiled as an aid to future efforts in the evaluation of various materials needed to perform specific functions for use in aerospace applications. Author, corporate source, and subject indexes are included to assist in locating specific items. Author

N64-26826 Illinois U., Urbana
THE EFFECT OF HEATING ON THE ROOM TEMPERATURE STRENGTH OF PRISTINE E-GLASS RODS
N. M. Cameron Nov. 1963 44 p refs
(Contract Nonr 2947(02)(X))
(T&AM-252; AD-425080)

The influence of temperature on the room-temperature strength of E-glass rods was studied. Groups of rods were heated in air at various temperatures in the range from 160° to 1,100° F. The strength versus temperature relation was qualitatively similar to that determined for E-glass fibers. Light and electron micrographs were made of the rod surface after various treatments. It is suggested that the most likely reason for the strength decrease, observed after heating, is an ordering or devitrification at the rod surface. Author

N64-26882 Union Carbide Corp., Lawrenceburg, Tenn. Advanced Materials Lab.
RESEARCH AND DEVELOPEMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XXXI: IMPREGNATION OF GRAPHITE Technical Report, Oct. 1961–May 1963
C. E. Waylett, M. B. Carter, and M. A. Spring Wright-Patterson AFB, Ohio, AF Maters. Lab., May 1964 65 p refs
(Contract AF 33(616)-6915)
(WADD-TR-61-72, Vol. XXXI; AD-602737)

This report discusses the impregnation of carbon and graphite materials with carbonaceous liquids and the subsequent heat treatment required to convert these liquids to coke and graphite in the pores of the base materials. The purpose of the impregnation process is to increase the strength and density and decrease the porosity of the finished articles. Impregnation procedures, the natures of the impregnants, and base stock structure affect the physical properties of impregnated graphite. Mercury porosimetry is used to define the pore structure of the bodies to be impregnated and aids in selecting impregnant and impregnating procedure. The physical properties of the impregnated graphite are related to the performance of nozzle inserts in a subscale solid-propellant rocket motor. Author

N64-26889 Atlantic Research Corp., Alexandria, Va.
CASTABLE CARBON FOR NOZZLE APPLICATIONS First Quarterly Progress Report, Mar. 2–Jun. 1, 1964
James D. Batchelor 18 Jun. 1964 25 p
(Contract AF 04(611)-9718)
(RPL-TDR-64-76; AD-602199)

The objective of this program is to demonstrate the advantages in terms of fabrication simplicity and cost reduction of a unique castable carbon material developed for rocket nozzle applications. To achieve this objective, materials studies and selection and the design and fabrication of nozzles for both a 5,000-lb- and 50,000-lb-thrust motor are to be carried out. Emphasis was placed on formulation studies. The effects of changes in binder content, filler solids composition, and fabrication techniques were investigated. Visual examination, mechanical testing, and thermal testing were used to judge the quality of test pieces. The first subscale nozzle was designed and partially fabricated. Castable carbon material will be used in the entrance section, as the insert backup insulation, and in the exit cone region. Author

N64-26891 Air Force Systems Command, Wright-Patterson AFB, Ohio Materials Lab.
PRINCIPLES AFFECTING HIGH STRENGTH TO DENSITY COMPOSITES WITH FIBERS OR FLAKES
S. W. Bradstreet May 1964 44 p refs
(ML-TDR-64-85; AD-603308)

The high strength of thin metallic and inorganic fibers, whiskers, and flakes can be exploited if they are properly protected and bonded together by a suitable adhesive or matrix material. The principles that appear to influence the strength of thin specimens and their mechanical behavior in such a matrix are reviewed. Qualitative attention is given to series and parallel failure mechanisms in the fibers, to the description of brittle behavior, to bonding and the mechanisms of stress

transfer, and to testing methods and evaluations. Semiquantitative relations are adduced to suggest optimization of mechanical properties, and composites containing SiC are discussed to illustrate these relations. Author

N64-26893 Union Carbide Corp., Lawrenceburg, Tenn. Advanced Materials Lab.
RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS, SUPPLEMENT TO VOLUME XII. DEVELOPMENT OF AN IMPROVED LARGE DIAMETER, FINE GRAIN GRAPHITE FOR AEROSPACE APPLICATIONS Technical Documentary Report, Sep. 1962–May 1963
R. L. Racicot and C. W. Waters Wright-Patterson AFB, Ohio, AF Mater. Lab., May 1964 39 p refs
(Contract AF 33(616)-6915)
(WADD-TR-61-72, Suppl. to Vol. XII; AD-602736)

Significant properties of raw materials, as they affect the final properties of grade RVA graphite, were the total porosity and kerosene apparent density. The more porous raw materials imparted higher strength to the finished RVA graphite, whereas those of higher density contributed to higher density of the finished graphite. Long lengths of 33-in.-diam RVA graphite were difficult to process without cracking. The longest length processed successfully under this project was 45 in. Author

N64-26894 IIT Research Inst., Chicago
RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XL: THE INFLUENCE OF FILLERS ON THE PYROLYSIS AND BONDING CHARACTERISTICS OF CERTAIN SYNTHETIC BINDERS Technical Documentary Report, Nov. 1960–31 Mar. 1963
C. W. Boquist, H. J. O'Neil, R. E. Putcher, and J. S. Griffith Wright-Patterson AFB, Ohio, AF Mater. Lab., May 1964 53 p refs Prepared for Natl. Carbon Co.,
(Contract AF 33(616)-6915)
(WADD-TR-61-72, Vol. XL; AD-602767)

The work described in this report presents the concluding part of a program concerned with the bonding and pyrolysis characteristics of two synthetic binders. The binders, alumina-condensed furfuryl alcohol resin and acenaphthylene pitch, were evaluated both by themselves and with selected fillers to determine binder–filler interactions during pyrolysis and to develop a more complete understanding of the carbon bonding process. In the discussion, the data accumulated from a number of techniques are presented and interpreted. Pyrolysis and physical property data for specimens molded with both the resin and pitch binders are also presented. Some fillers are essentially unbondable by carbon, while others can materially alter binder pyrolysis. Author

N64-26913 Battelle Memorial Inst., Columbus, Ohio
SUMMARY OF THE EIGHTH MEETING OF THE REFRACTORY COMPOSITES WORKING GROUP
E. S. Bartlett and H. R. Ogden 20 Apr. 1964 26 p refs
(Contract AF 33(615)-1121)
(DMIC-MEMO-192; AD-602476)

This paper summarizes information on refractory materials and composites as presented at the Eighth Meeting of the Refractory Composites Working Group in Fort Worth, Texas, January 14–16, 1964. This memorandum is based on 45 papers covering a wide variety of subjects ranging from basic studies on oxidation mechanisms to the development of specific pieces of hardware. The papers are reviewed and discussed briefly within the framework of four broad areas—materials technology, process technology, specific hardware applications, and evaluation techniques. Included in the section on materials technology are discussions dealing with bulk refractory materials and coated-metal systems. Hot spraying, chemical vapor deposition, powder processes, joining, and extrusion are discussed in the section on process technology. The specific hardware applications cover rocket-motor components, nose caps, leading edges, hot skins, and fasteners. Author

20 MATHEMATICS

Includes calculation methods and theory; computers; data processing; and numerical analysis. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; and 22 Navigation and Guidance.

N64-25851 Joint Publications Research Service, Washington, D.C.
HIGH SPEED COMPUTER MEMORIES
V. V. Bardizh and V. I. Perekatov 7 Jul. 1964 33 p refs Transl. into ENGLISH of the Booklet "Flyuksor Kak Element Zapominayushchikh Ustroystv" Moscow, 1962 p 1–48
(JPRS-25360; TT-64-31633) OTS: $1.00

This paper discusses some problems in dealing with the characteristics of two different circuits using 3-hole memory cores, including the possibilities of using these circuits in operational memory units. Work was carried out to develop new elements for operational memory units using magnetic elements; among these elements, considerable attention was given to ferrite elements with complex configurations; 3-hole memory cores and these ferrite elements belong to the same group. G.D.B.

N64-25860 Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
VARIOUS METHODS AND COMPUTER ROUTINES FOR APPROXIMATION, CURVE FITTING, AND INTERPOLATION
J. F. Price and R. H. Simonsen Jul. 1963 162 p refs
(D1-82-0151)

The following problems are discussed: (1) problems using "exact" data—interpolation problems, extrapolation, numerical differentiation, and approximations that do not in general pass through the given points exactly, and (2) fitting curves and surfaces to sets of "approximate" data— method of least squares, minimax methods, and smoothing of data. Also presented is a select group of 7090/94 programs often used for the above problems. R.T.K.

N64-25946 New York U., N.Y. Courant Inst. of Mathematical Sciences
ON THE ESTIMATION OF CONTRASTS IN LINEAR MODELS
Madan L. Puri and Subha Bhuchongkul Apr. 1964 13 p refs
(Contracts Nonr-285(38); Nonr-222(43))
(IMM-NYU-323; AD-600278)

In linear models with several observations per cell, a class of estimates of all contrasts is defined in terms of rank test statistics, such as the Wilcoxon or normal scores statistic. The asymptotic efficiency of these estimates relative to the standard least squares estimates, as the number of observations in each cell gets large, is shown to be the same as the Pitman efficiency of the rank tests on which they are based to the corresponding t-tests. Author

N64-25961 Navy Electronics Lab., San Diego, Calif.
MULTILEVEL QUANTIZATION OF DATA FOR SEQUENTIAL TESTING Research Report No. 1218

R. A. Worley 10 Apr. 1964 40 p refs
(NEL-1218; AD-601313)

The applications of statistical decision theory to the design of automatic radar detection systems are considered. The statistical properties of sequential methods were investigated. The results of multilevel quantization of a variable, which has a value in a continuous range, are presented for a sequential probability ratio test. R.T.K.

N64-25967 Grumman Aircraft Engineering Corp., Bethpage, N.Y. Advanced Development Program

ON MINIMIZING ERROR PROPAGATION IN SOLVING SECOND ORDER NONLINEAR DIFFERENTIAL EQUATIONS

Chong-Hung Zee Apr. 1964 16 p refs
(ADN-02-08-62.1)

After examining the relationship between the truncation errors associated with reciprocal extrapolation of a function from two points, a method is proposed for computing the truncation errors of those power series developed when the direct power series substitution technique is applied to the solution of second order nonlinear differential equations. With roundoff error neglected, the value of the solution is determined accurately at any desired point; hence error propagation in the method of continuous analytic continuation is practically eliminated.
Author

N64-25981 Northwestern U., Evanston, Ill.

MULTIPLE DISCRIMINANT FUNCTIONS

Emilio Casetti May 1964 67 p refs
(Contract Nonr-1228(26))
(TR-11; AD-600575)

The following are included in this document: multiple discriminant functions; introductory description of LDF's (linear discriminant functions); derivation of LDF's; discrimination power and some relevant properties of LDF's; and a multiple discriminant-functions program. R.T.K.

N64-26054 California U., La Jolla Inst. of Geophysics and Planetary Physics

AUSER'S GUIDE TO BOMM A System of Programs for the Analysis of Time Series

E. C. Bullard, F. E. Oglebay, W. H. Munk, and G. R. Miller Apr. 1964 108 p
(Grant NSF-13575)
(AD-435778)

BOMM is a system of programs that cause an electronic computer to perform arithmetic operations on time series. In devising the system the main objectives were to enable a wide variety of data formats to be accepted without recoding, to allow gross errors to be automatically removed from data, to provide a considerable variety of arithmetic operations and leave the user free to choose the order in which they are applied, and to allow further processes to be incorporated into the system. G.D.B.

N64-26083* California U., Berkeley Electronics Research Lab.

ON THE EVALUATION OF OPTIMAL AND NONOPTIMAL CONTROL STRATEGIES

E. Polak Repr. from IEEE Trans. Autom. Control, v. AC-9, no. 2, Apr. 1964 2 p refs
(Grant NsG-354)

The prediction of the maximum probable improvement in the performance of a system, which has been converted from nonoptimal or quasi-optimal operation, is discussed. In obtaining this prediction it is necessary to have some definite measure of performance that can be used for comparing the performance of different systems. With regard to regulator systems, the most likely significant aspects of performance in terms of the optimal control cost function are average estimated cost and maximum cost for a single process within a specified class. These aspects of performance are defined explicitly, and methods for their computation, based on the properties of optimal controls, are suggested. P.V.E.

N64-26109 Aerospace Corp., El Segundo, Calif. Plasma Research Lab.

COMPARISON OF FOKKER-PLANCK AND BHATNAGAR-GROSS-KROOK EQUATIONS

M. S. Grewal 5 Jun. 1964 26 p
(Contract AF 04(695)-269)
(SSD-TDR-64-115; TDR-269(4280-30)-2; AD-602960)

A Fokker-Planck equation, such as the one used in the theory of Brownian motion, and the Bhatnagar–Gross–Krook equation that conserves only number density are compared via their transition probabilities. These two equations were used in various problems arising in the study of plasmas. For time intervals large compared with the average collision time both equations give the same results. For the opposite limit of times small compared with the collision time, the disparity between the two equations increases as the initial velocity of the test particle increases; however, the difference between the two transition probabilities is reduced if the initial velocity distribution is Maxwellian. Author

N64-26110 Aerospace Corp., El Segundo, Calif. Applied Mechanics Div.

THE EFFECTS OF STATE VARIABLE DISCONTINUITIES IN THE SOLUTION OF VARIATIONAL PROBLEMS

Rollyn G. Graham 7 Jul. 1964 33 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-142; TDR-269(4550-20)-4; AD-602480)

Some necessary, but not sufficient, conditions for an extremal solution are developed for two types of variational problems in which state variable discontinuities are permitted. The types of problems are characterized by the fact that the magnitudes of the discontinuities are defined by specified relationships. The necessary conditions result in discontinuities in the Lagrange multipliers at the points of discontinuity in the state variables. Steepest-ascent methods are described for solving problems occurring in engineering practice. Two analytical example problems, one with both the magnitude and occurrence of the discontinuity defined and one with only the magnitude defined, are presented and solved by the indirect methods of the calculus of variations. Author

N64-26118 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

ON THE THEORY OF OPERATOR COMPUTATION

V. A. Ditkin 14 May 1964 6 p refs Transl. into ENGLISH from Kok. AN SSSR, Mat. (USSR), v. 116, No. 1, 1957 p 15-17
(FTD-TT-64-325/1; AD-602341)

Mikuskinski's theory for constructing operators by means of a ring of functions is discussed, and the operator computation for the operator d/dt t d/dt is executed. This operator can be constructed starting out from the corresponding integral conversion, which is the Laplace analogous conversion,

$$\bar{\phi}(p) = 2\int_0^\infty \phi(t) K_0(2\sqrt{pt})\, dt.$$

If the measurable function $\phi(t)$ satisfies the condition

$$|\phi(t)| < Qe^{2\gamma_0\sqrt{t}}$$

where q and $\gamma_0 > 0$ are the constants, then the integral in the region $\mathrm{Re}\sqrt{p} > \gamma_0$ converges and represents, in this region, an analytical function. The inverse conversion that occurs is

$$\phi(t) = 1/2\pi i \int_{L} \bar{\phi}(p)\, I_0(2\sqrt{pt})\, dp,$$

where the path of the integration of L is any parabola

$$\mathrm{Re}\sqrt{p} = \gamma > \gamma_0.$$

I.v.L.

N64-26120 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

CONSIDERING THE SYNTHESIS OF DISCRETE SYSTEMS BY THE METHOD OF POLYNOMIAL EQUATIONS

M. R. Yelistratov 18 Jun. 1964 24 p refs Transl. into ENGLISH from Automat. i Telemekh. (Moscow), v. 24, no. 11, 1963 p 1474–1486

(FTD-TT-64-333/1+4; AD-602347)

The problem is solved of calculating the optimal controller in a closed control system taking into account the preservation of the system coarseness. These criteria of optimization are examined: the minimum of dispersion of the system random error under a given coefficient of dynamic error and the minimum of the sum error of conversion. The problem was solved with the aid of polynomial equations. Author

N64-26124 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

ON THE INSOLUBILITY OF CERTAIN TOPOLOGICAL PROBLEMS

A. Markov 12 May 1964 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 123, no. 6 1958 p 978–980

(FTD-TT-64-466/1; AD-602316)

This report is devoted to the intensification and the structural perfection of the results formulated in a memorandum that pertained to the problem of the homemorphism of polyhedrals, designated by their triangulation schemes. Emphasis is placed on the binary ratio between complexes and on the concept of the combinatorial equivalence of complexes. I.v.L.

N64-26169 Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.

STUDY AND INVESTIGATION TO DEVELOP COMPILER TECHNIQUES REQUIRED FOR PROGRAMMING THE PARALLEL NETWORK COMPUTER Final Report

Frank J. Tomaini Griffiss AFB, N.Y., RADC, Jun. 1964 103 p

(Contract AF 30(602)-3146)

(RADC-TDR-64-175; AD-602506)

The purpose of this report is to introduce and define an assembly language for the Parallel Network Computer System. This sequential system is designed for parallel computation with the integration of two control units, two arithmetic units, and an interrupt system into a network unit with a common memory bank and a network of identical processing elements (PE). The assembly language permits the programer to use mnemonic operation codes rather than binary machine language, to write constants in several forms—binary, octal, decimal, or hexadecimal. Coding form, addresses, and pool constants are described. Central computer, processing element, input–output, macro instructions, and pseudoinstructions are discussed and summarized. A list of fixed symbols is given. I.v.L.

N64-26194 RAND Corp., Santa Monica, Calif.

THE APPLICATION OF DYNAMIC PROGRAMMING TO A LINEAR TIME-VARYING SYSTEM

F. T. Smith Jul. 1964 43 p refs

(Contract AF 49(638)-700)

(RM-4099-PR; AD-602417)

This report discusses the application of dynamic programming to dynamic systems that can be described by linear time-varying differential equations. Two different mathematical formulations of the problem are discussed. One method is based on defining a relative system state vector, and the other on defining a combined system state vector. It is shown how the two expressions obtained for the optimal control vector are equivalent. The two approaches are discussed in terms of a satellite rendezvous problem, and some computational formulas are derived for computing an approximate solution. Author

N64-26207 Litton Systems, Inc., Woodland Hills, Calif. Guidance and Control Systems Div.

LOGICAL DETERMINISM IN NETWORK SYNTHESIS Technical Documentary Report, Apr. 1963–Apr. 1964

J. Robert Logan et al Wright-Patterson AFB, Ohio, AF Avionics Lab., Apr. 1964 138 p

(Contract AF 33(657)-11052)

(AL-TDR-64-80; AD-602708)

This report is concerned with network synthesis as it would exist under the philosophy of logical determinism. The basic working concepts of this philosophy are discussed. Some of the mechanics of handling data are reviewed with regard to input–output schemes and the formats that are employed. A synopsis of congruent partitioning provides a base for further development. Deterministic factoring is discussed and illustratively applied to a sample system. Sequential networks are depicted as a result of further treatment of deterministic factoring. It is shown how novel logic elements can be processed by the basic congruent partitioning theory by its application to the sample case of exclusive OR circuitry. Author

N64-26241 David Taylor Model Basin, Washington, D.C. Acoustics and Vibration Lab.

THEORETICAL AND EXPERIMENTAL DETERMINATION OF DAMPING CONSTANTS OF ONE- TO THREE-DIMENSIONAL VIBRATING SYSTEMS

Ralph C. Leibowitz and E. H. Kennard Jun. 1964 37 p refs

(DTMB-1770; AD-602618)

Formulas are deduced for vibrating systems of one, two, and three dimensions. Undamped and damped free vibrations and harmonic forced vibrations are treated. Methods are proposed for calculating the damping constants from test observations. Author

N64-26274 Brookhaven National Lab., Upton, N.Y.

STEAM: A COMPUTER PROGRAM TO ANALYZE SPARK CHAMBER DATA OBTAINED BY USE OF AN AUTOMATIC FLYING SPOT DIGITIZER

S. Heller, L. Padwa, and I. Perlman Dec. 1963 30 p

(Sponsored by the AEC)

(BNL-833 (T-237) OTS: $0.75

A new film-reading system has been designed to analyze spark-chamber pictures obtained during elementary particle experiments. An off-line automatic flying spot digitizer was built, and computer programs (STEAM) were written to process data produced by the digitizer. All spark-chamber film data obtained by the digitizer will have similar routines for their analysis, regardless of the size, shape, or type of chambers employed. The general approach of the digitizer-STEAM program arrangement is to locate fiducials, transform the data to a suitable coordinate system, perform data reduction by a sorting scheme, line up sparks on tracks, and do a kinematical analysis. A description is presented of the STEAM programs. P.V.E.

N64-26285 Philco Corp., Palo Alto, Calif. Western Development Labs.
INPUT FORMATS AND DATA FOR SETUP OF ERROR PROPAGATION RUN
16 p
(WDL-TR-2185, Addend. 1)

This addendum contains the information required to set up a data run for the interplanetary error propagation program. It contains input data card formats, table of input quantities, a list of locations of constants (variances), and a list of constants presently compiled in common storage. Author

N64-26300 Joint Publications Research Service, Washington, D.C.
OPTIMAL SOLUTIONS FOR GAMES WITH BLUFFING AND HIGH-SPEED CONTROL
M. A. Genin and B. G. Pittel' 23 Jun. 1964 36 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), v. XIX, no. 1, 1964 p 26–35, 76–87
(JPRS-25221; TT-64-31543) OTS: $1.00

CONTENTS:
1. SOLUTION OF A DISCRETE TWO-PERSON GAME WITH BLUFFING M. A. Genin p 1–14 refs
2. ONE OPTIMAL CONTROL PROBLEM B. G. Pittel' p 15–32 refs

N64-26358* Martin Co., Baltimore, Md. RIAS Div.
FUNDAMENTAL INEQUALITIES FOR DISCRETE AND DISCONTINUOUS FUNCTIONAL EQUATIONS
G. Stephen Jones Repr. from J. Soc. Indust. Appl. Math., v. 12, no. 1, Mar. 1964 p 43–57 refs
(Contracts NASr-103; AF 49(638)-382; Nonr-3693(00))

A series of lemmas are presented that contain inequalities, which may be of use in the theory of finite difference equations and more general discontinuous functional equations. To illustrate the application of these lemmas, several results concerning boundedness and stability of solutions are presented. R.T.K.

N64-26377 Joint Publications Research Service, Washington, D.C.
OPERATIONS ON UNITS IN COMPLEX SYSTEMS
N. P. Buslenko and O. M. Yurkevich *In its* Tech. Cybernetics 19 Jun. 1964 p 1–15 refs (See N64-26376 18-16) OTS: $4.00

Types of operations on units connected with the structural analysis and synthesis of A-systems are investigated. The concepts of equality and equivalence of units are studied. An operation for production of these units is introduced, and their basic properties are considered. Author

N64-26380 Joint Publications Research Service, Washington, D.C.
AN ALGORITHM FOR RECOGNITION OF OBJECTS WITH MANY PARAMETERS AND ITS APPLICATIONS
V. L. Brailovskiy *In its* Tech. Cybernetics 19 Jun. 1964 p 45–63 refs (See N64-26376 18-16) OTS: $4.00

An algorithm is described for recognition of objects with many parameters based on certain assumptions. Methods of amplification of the algorithm are illustrated by model problems solved on a digital computer. Examples of applied problems solved by using the algorithm are presented. Author

N64-26381 Joint Publications Research Service, Washington, D.C.
EXPERIMENTS IN VISUAL SHAPE RECOGNITION BY A DIGITAL COMPUTER
Yu. G. Grigor'yan *In its* Tech. Cybernetics 19 Jun. 1964 p 64–77 refs (See N64-26376 18-16) OTS: $4.00

The problem of recognition of handwritten letters from 0 to 9 by a digital computer is investigated. The images have standard vertical dimensions and were placed approximately in the center of the field of vision. The principle of the shortest distance between shapes was used as the basis for the work. To do this a metric space is constructed—the space of a set of finite sets that, in particular, is considered to be a receptor space. The entire image is divided into a set theoretic sum of sets each of which sums is characterized by the corresponding tone. Such a representation permits deduction of the shape of the space between figures consisting of many tones. The important point in the given recognition algorithm is the calculation of the statistical relationship of one shape to all the rest by means of the spaces introduced between the figures. Experiments carried out on a digital computer showed a high percent of accuracy in recognition (93%). Author

N64-26382 Joint Publications Research Service, Washington, D.C.
SOME PROBLEMS IN THE THEORY OF SHAPE IDENTIFICATION
I. Ya. Levin *In its* Tech. Cybernetics 19 Jun. 1964 p 78–86 refs (See N64-26376 18-16) OTS: $4.00

A method is discussed for construction of resolving rules for problems in shape identification based on an approximation of the logarithm of the similarity ratio by statistics depending on selected statistical characteristics of the objects identified. As an illustration, results are presented for solution of a problem in the field of medical diagnostics. Author

N64-26389 Joint Publications Research Service, Washington, D.C.
SOME TOPOLOGICAL PROCEDURES FOR THE INVESTIGATION OF LINEAR STRUCTURES
Yu. F. Maksimenko *In its* Tech. Cybernetics 19 Jun. 1964 p 153–171 refs (See N64-26376 18-16) OTS: $4.00

A relationship is investigated between the passage of signals and the transfer functions of system. A universal algorithm is proposed for the calculation of transfer functions. Author

N64-26390 Joint Publications Research Service, Washington, D.C.
CONCERNING THE DEGREE OF STABILITY OF NONLINEAR SYSTEMS IN A SLIDING CONDITION
Ye. I. Gerashchenko *In its* Tech. Cybernetics 19 Jun. 1964 p 172–183 refs (See N64-26376 18-16) OTS: $4.00

One of the problems of synthesis of some systems with variable structure is investigated. A method is given for the selection of values of a sliding parameter retaining the highest degree of stability. Author

N64-26458* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ALGORITHM 229 ELEMENTARY FUNCTIONS BY CONTINUED FRACTIONS
James C. Morelock Repr. from Commun. of the ACM, v. 7, no. 5, May 1964 p 296
(NASA-RP-261)

The procedure described utilizes a continued fraction that is equivalent to the diagonal of the Padé table for exp $\underline{x}$, with error in the computed convergent less than $x^{2n}/2 \times 6^2x(10)^2x...x(4n-2)^2(4n+2)$. The argument $\underline{x}$ is assumed to be less than $\pi/4$. R.T.K.

N64-26460 Joint Publications Research Service, Washington, D. C.
A NUMERICAL METHOD OF SOLVING CERTAIN PROBLEMS OF OPTIMUM CONTROL
B. N. Pshenichnyy 29 Jul. 1964 27 p refs Transl. into ENGLISH from Zh. Vychislitel'noy Mat. i Mat. Fiz. (Moscow), v. 4, no. 2, Mar.–Apr. 1964 p 292–305
(JPRS-25636; TT-64-31908) OTS: $2.00

The problems of optimum control are discussed for systems, the phase coordinates of which are expressed by control in definite form. Included are systems of linear differential equations. Also discussed is the formulation of some necessary condition of optimality of linear systems with phase limitations. P.V.E.

N64-26461 Joint Publications Research Service, Washington, D.C.
ONE METHOD OF SELECTING AN INSERTED VARIABLE IN THE SIMPLEX METHOD OF LINEAR PROGRAMMING
V. A. Mash 29 Jul. 1964 9 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 4, no. 2, Mar.–Apr. 1964 p 376–379
(JPRS-25637; TT-64-31909) OTS: $1.00

A method is described for selecting the inserted or artificial variable for a problem of linear programing. (In some such problems, the system of limitations contains no diagonal matrix, thus necessitating solution by successive plan improvements. In these cases, artificial variables are used, as a rule, whose coefficients constitute or supplement the diagonal matrix.) Instead of basing variable selection on the fastest elimination of the variables, the suggested method bases the selection on optimal elimination of the variables, where "optimal" is defined in terms of slow decrease of the sum of the variables and minimum increase of the functional. D.E.W.

N64-26473 Mound Lab., Miamisburg, Ohio
VARIATIONAL METHOD FOR LEAST SQUARES SOLUTIONS OF LINEAR AND NON-LINEAR EQUATIONS
Kenneth C. Jordan 26 Jun. 1964 12 p
(Contract AT(33-1)-GEN-53)
(MLM-1186) OTS: $0.50

A variational method of applying the principle of least squares to curve fitting is presented to solve half-life data involving more than one radioactive isotope. The method applies equally well to equations that have linear or nonlinear constants. In both cases the variational method has advantages over standard methods, although the most probable values and probable errors are the same by both methods. Author

N64-26479 Swedish State Shipbuilding Experimental Tank, Goteborg
MATHEMATICAL REPRESENTATION OF ORDINARY SHIP FORMS
Ake Williams Scandinavian U. Books, 1964 73 p refs *Its* Publ. no. 55

An account is given of a method of calculation concerning mathematical formulation of ship forms. The hull surface is defined by a small number of draft functions that indicate the size of the selected form parameters of the waterline sections. These draft functions are extremely useful when carrying out systematic variations of ship forms and also for single ship projects, as the functions may include curves for displacement, statical moment, moment of inertia, etc. As an introduction, a short review is given regarding mathematical ship lines and their use when carrying out hydrodynamical calculations, model testing, projecting ships, and building ships. A short survey of literature is also given with the intention of classifying the different delineation methods. Ordinary polynomials are used for expressing the waterline sections and some of the draft functions. Using these the calculations are carried out by a main program. The numerical determination of entrance data is performed by an auxiliary program. Investigations were made to show the influence of varying sets of form parameters and degrees of polynomials. Author

N64-26497 Boeing Scientific Research Labs., Seattle, Wash.
BOUNDS FOR THE RANK OF THE SUM OF TWO MATRICES
Mathematical Note No. 344
George Marsaglia Apr. 1964 13 p refs
(DI-82-0343; AD-600471)

This paper gives upper and lower bounds on the rank of the sum of two matrices, and discusses their connection with the condition that rank be additive over a set of matrices. Author

N64-26531 Wisconsin U., Madison Theoretical Chemistry Inst.
STATISTICAL MECHANICS AND IRREVERSIBILITY
Frank C. Andrews 20 Feb. 1964 20 p refs
(Grant NSF G-20725)
(WIS-TCI-38; AD-600072)

The problem of obtaining irreversible evolution equations in statistical mechanics from reversible equations of motion is discussed. The sense in which mechanics gives rise to irreversibility is considered to rest on a clear understanding of the problem statistical mechanics attempts to solve. A discussion of the mechanical view of the second law of thermodynamics is also given. Author

N64-26539 Sandia Corp., Albuquerque, N. Mex.
THREE DIMENSIONAL SURFACE FIT M-151
David G. Kitzinger Jul. 1964 21 p
(Sponsored by AEC)
(SC-RR-64-546) OTS: $0.50

The M-151 computer method permits a three dimensional array to be represented by a mathematical equation. This method uses nth order multiple interpolation with extensive transformation of variables to describe most three dimensional functions. An error analysis aids the programer in choosing the best fit of a function from successive approximations of that function. Author

N64-26560 European Organization for Nuclear Research, Geneva (Switzerland) Data Handling Div.
A FORTRAN PROGRAMME AND SOME NUMERICAL TEST RESULTS FOR INTEGRATION OVER A TRIANGLE
K. S. Kolbig 25 Jun. 1964 49 p refs
(CERN-64-32)

Results of test integrations over triangles are presented. Formulas for various functions, including those with singularities, were used in the test integrations. A description is given of the general subdivision algorithm used. A FORTRAN II program was written, and the method of using the program is explained; two examples are presented. The program can be used for calculating integrals over polygons. P.V.E.

N64-26634 Grumman Aircraft Engineering Corp., Bethpage, N.Y. Research Dept.
VARIATIONAL PROBLEMS WITH AN ARGUMENT LAG
D. Boyanovitch Mar. 1964 21 p refs
(RN-179)

Lemmas analogous to the fundamental lemmas of the calculus of variations are developed for the problems of calculus of variations wherein an argument lag occurs. A somewhat detailed survey of the Russian effort in this area is presented. P.V.E.

N64-26647 Purdue U., Lafayette, Ind. School of Aeronautical and Engineering Sciences.
ON THE EQUIVALENCE OF POLYNOMIAL AND FUNCTIONAL FORMS OF CONSTITUTIVE EQUATIONS FOR A CLASS OF LARGE DEFORMATIONS
K. C. Valanis Nov. 1963 31 p refs Prepared for Lockheed Propulsion Co.
(Contract AF 94(611)-8539)
(A&ES-63-10; AD-439647)

The special class of small, time-dependent deformations superposed on large static deformations are considered. General constitutive relations are obtained from a particular polynomial formulation. More restricted relations may be obtained by reducing the generality of the form of the polynomials. In particular, a class of materials is postulated, the viscoelastic nature of which can be described by 2 relaxation functions as opposed to 12 relaxation functions that are necessary for the more general solids. An even more restricted class of materials can exist where one relaxation function suffices to define the viscoelastic behavior of the solid. P.V.E.

N64-26683 Rochester U., N.Y.
EXACT SOLUTION OF THE SCHROEDINGER EQUATION FOR INVERSE FOURTH POWER POTENTIAL
Richard M. Spector 6 Mar. 1964 20 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-23)

The solution of the Schroedinger equation for the potential $V(r) - V/(\mu r)^4$ and all angular momenta is given in terms of known functions, namely the solutions to the modified Mathieu equation with complex parameters and complex argument. Scattering solutions for both attractive and repulsive potentials are given, and in the latter case the explicit expression for the S-matrix is given. Author

N64-26693 Bureau of Mines, Denver, Colo.
COMPUTER METHODS OF FITTING SURFACES TO ASSAY AND OTHER DATA BY REGRESSION ANALYSIS
Richard F. Link, George S. Koch, Jr., and George W. Gladfelter (Princeton U.) [1964] 75 p refs Prepared in Cooperation with Oregon State U.
(Grant NSF-G-14189)
(BM-RI-6508)

Contour maps, useful in mineral industries, for example, in analysis of trends in mineralization, may be constructed through statistical methods of regression analysis programed for an electronic computer. For many applications, the resulting maps are more useful and objective than conventional contour maps that are necessarily subjective because they are drawn by hand methods. In principle, an equation is found that fits a quadratic surface to observed elevations of points referred to a datum plane. The quadratic surface, represented by a contour map, may take the form of a ridge, valley, dome, or basin. Once an equation has been derived, its coefficients may be used to construct a contour map showing lines of equal value that are derived from the original observed data points by the averaging process of fitting the quadratic surface. Methods employed are illustrated by an example analysis, based on data from a large vein of the Fresnillo mine, Zacatecas, Mexico. Computer programs to implement the methods are described. Author

N64-26846 Michigan U., Ann Arbor Cooley Electronics Lab.
COMPUTATIONAL TECHNIQUES FOR SCHEDULING PROBLEMS WITH DEFERRAL COSTS
E. L. Lawler Apr. 1964 22 p refs
(Contract AF 30(602)-2661)
(TR-140; Rept.-04967-1-T; AD-603525)

A class of scheduling problems involving deferral costs was formulated by McNaughton, who described a simple method of solution for the linear, single-processor case. In this report dynamic programing and linear programing techniques are applied to nonlinear and multiple-processor problems. A dynamic programing solution of the nonlinear, single-processor problem is possible, provided the number of jobs is small. Transportation methods of linear programing can be used to solve large nonlinear, multiple-processor problems, provided the processing times for the jobs are equal. Approximate and/or partial solutions are possible for other cases. Author

N64-26847 Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.
NONLINEAR SHELL MATRIX ANALYSIS Technical Documentary Report, 15 Jan.–15 Dec. 1963
B. Klein, G. Kimura, S. Knisley, I. Stierle, and C. Wittkow Wright-Patterson AFB, Ohio, Res. and Tech. Div., Feb. 1964 257 p refs
(Contract AF 33(657)-10192)
(SSD-31116R; RTD-TDR-63-4255; AD-603527)

A computer program is presented for solving a large class of complex nonlinear shell problems. The nonlinearities are due to large deflection effects. Initial imperfections are included in the formulation. The computer program consists of input, diagnostic, matrix setup, and matrix solution. The matrix is set up by integrating the shell equations. The nonlinear terms are treated in a separate matrix. The solution is carried out in a step-by-step method. Examples are given to illustrate the methods and the computer program with recommendations given for increasing the capability of the latter. Author

N64-26863 Aberdeen Proving Ground, Maryland Ballistic Research Labs.
A COMPUTER PROGRAM FOR AUTOMATIC STAR IDENTIFICATION
Anojean Wagner Dec. 1963 30 p refs
(BRL-MR-1535; AD-602728)

This report describes an automatic star identification program. The identification of stars is obtained from the Boss Catalog data recorded on magnetic tape, and standard coordinates are computed. The output format is compatible with the input format of the camera orientation programs. Author

N64-26867 RAND Corp., Santa Monica, Calif.
DATA SYSTEM DESIGN AND CONTROL USING AUTOSATE—AN AUTOMATED DATA SYSTEM ANALYSIS TECHNIQUE
O. O. Butler, E. M. Fairbrother, and O. T. Gatto Feb. 1964 252 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3976-PR; AD-430136)

This memorandum describes an automated technique that can be used as an aid by providing information on data-system flows and characteristics for the data-system analysis phase and by furnishing a useful tool to guide system design and control. This automated data system technique (AUTOSATE) is executed in three phases: (1) documenting system data flows; (2) translating the analysis inputs into machine-readable form; and (3) preparing a series of analysis reports by computer. Although initially designed as a tool with which to examine existing data systems, AUTOSATE can be used during the feasibility phase of an electronic data-processing study and can be applied to an examination of a variety of Air Force base-data processing systems, to an examination of a foundation for classifying, selecting, and designing different segments of data systems, and to developing principles for system design. The technique further suggests a mechanical means for describing personnel jobs and tasks. Included in this memorandum are all the operator instructions, program logic flow charts, and FORTRAN instruction listings. I.v.L.

N64-26870* Northeast Louisiana State Coll., Monroe
THE SELECTION OF A MULTIVARIABLE APPROXIMATING FUNCTION SATISFYING A GIVEN ERROR TOLERANCE IN THE SENSE OF LEAST SQUARES Annual Report, May 1, 1963–Apr. 30, 1964
Daniel E. Dupree, F. L. Harmon, R. A. Hickman, Edward Anders, and James O'Neil [1964] 14 p refs
(Contract NAS8-2642)
(NASA-CR-58207) OTS: $1.60 ph

A technique for obtaining a function that yields an error, in the sense of least squares, that is less than a specified tolerance is developed. Author

N64-26897 International Business Machines Corp., Yorktown Heights, N.Y. Thomas J. Watson Research Center
DESIGN MECHANIZATION OF A PROBLEM-ORIENTED SYMBOL PROCESSOR Final Report
R. F. Schauer, W. Notz, and A. Mullery 1 May 1964 40 p
(Contract AF 19(628)-2991)
(AFCRL-64-454; AD-603200)

This note contains appendices concerning design mechanisms of a problem-orientated symbol processor. Specially considered are these: (1) basic logic design; (2) diagnostic programs; (3) read-only memory (ROM); and (4) algol arithmetic compiler. J.L.C.

N64-26935 Radio Corp. of America, Camden, N.J. Defense Electronic Products
NEURISTOR LOGIC TECHNOLOGY Final Report
Griffiss AFB, N.Y., RADC, Jun. 1964 207 p refs
(Contract AF 30(602)-2761)
(RADC-TDR-64-123; AD-602656)

The objective of the contract was to investigate the feasibility of high-speed computers in which all signals are in the form of optical energy. The major portion of the investigation was devoted to the concept, realization, and demonstration of an optical saturable absorber. The saturable absorber is an important invention, since it provides the threshold function for all forms of all optical computers. Two general forms of optical computers were investigated. The first was based on an optically pumped scheme using neuristor-like lines produced from fiber optic lasers. This investigation included a theoretical study of energy flow, pulse shaping, material and pumping requirements, and experimental evaluation of suitable neuristor materials. The other form of optical computer investigated was based on electrical pumping and consisted of coupled laser resonators. This study was confined to determining the material requirements and device configuration. The final section of the report describes an experimental investigation of a fast light pulse generator and associated detection equipment necessary to test future materials for optical computers. Author

N64-26937 Westinghouse Electric Corp., Baltimore, Md. Computer and Data Systems Technology Group
MULTIPLE PROCESSING TECHNIQUES Final Report
Griffis AFB, N.Y., RADC, Jun. 1964 111 p
(Contract AF 30(602)-3417)
(RADC-TDR-64-186; AD-602693)

This report describes the design and operating principles of the Solomon II computer; the basic concept is similar to the parallel network computer Solomon. The parallel network computer design consisted of 1,024 processing elements operating in parallel on a single problem under the control of a central unit. It produced a system that, when applied to many applications, is much faster than present day computers. The Solomon II computer design resulted in some logical changes to the processing elements developed for the parallel network computer to produce a much faster computing element. These changes resulted in a fixed word length and in extremely fast add and multiply operations. Also, changes were made in the control unit and in the programing, to produce more rapid operating system. Author

N64-26944 International Business Machines Corp., Yorktown Heights, N.Y. Thomas J. Watson Research Center
DESIGN MECHANIZATION OF A PROBLEM-ORIENTED SYMBOL PROCESSOR Final Report
R. F. Schauer, W. Notz, and A. Mullery 1 May 1964 224 p
(Contract AF 19(628)-2991)
(AFCRL-64-454; AD-603201)

The hardware microcomputer for Adam (MIMIC) was originally designed in simple AND and OR logic. This microcomputer was then converted to logic based on the specifications listed of a high-speed AND–OR–INVERT circuit family with the aid of logic automation programs. The result is a set of logic diagrams. A data-flow diagram for the MIMIC is presented. Three boxes represent the read-only memory, the fast memory, and a core memory. These memories have been designed with special circuits and are not represented, in any detail, in the accompanying set of logic drawings. The remaining 14 boxes represent the subunits into which the MIMIC system has been divided. A set of diagrams corresponding to each of these boxes is presented. I.v.L.

N64-26954 Naval Ordnance Lab., White Oak, Md.
A HIGH SPEED COMPUTER TECHNIQUE TO DETERMINE NOZZLE CONTOURS FOR SUPERSONIC WIND TUNNELS
James Conlan and George Trytten Jul. 1964 29 p refs
(NOLTR-64-81; M-51; AD-603022)

This report describes a computer program developed to calculate contours for supersonic wind tunnel nozzles. Both two-dimensional and axisymmetric flow is covered, and the technique arises from the method of characteristics in the theory of solution of hyperbolic partial differential equations. Author

N64-26957 Applied Logic Corp., Princeton, N.J.
AUTOMATED LOGIC FOR SEMI-AUTOMATED MATHEMATICS Scientific Report No. 1
James R. Guard 30 Mar. 1964 67 p refs
(Contract AF 19(628)-3250)
(AFCRL-64-411; AD-602710)

Future possibilities of proving mathematical theorems on a computer on a man–machine basis are reported. In this report are the descriptions of some algorithms (six formal systems of logic, S_1 through S_2) that verify certain "trivial" proofs. The systems S_1 through S_4 are considered in order to simplify the descriptions of S_5 and S_6. Mechanisms used in the logic systems are classical propositional calculus, branding rules, and the matching process. A.L.B.

21 METEOROLOGY

Includes climatology; weather forecasting; and lower atmosphere studies. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 29 Space Sciences.

N64-25869 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
METEOROLOGICAL DATA REPORT, AEROBEE KP 3.3
Gordon L. Dunaway Jan. 1964 43 p refs
(ERDA-103; AD-439680)

Meteorological data gathered for the launching of Aerobee KP 3.3 are presented for ballistic studies. Calculated ballistic data are included. Author

N64-25876 Suffield Experimental Station, Ralston, Alberta (Canada)
DOWNWIND POSITION OF GLASS BEADS EMITTED FROM AIRCRAFT
E. R. Walker 12 Feb. 1964 44 p refs
(SES-TN-136; AD-437136)

Glass beads of mass mean radii 28μ and 54μ were emitted from aircraft flying at heights of about 300 ft and 1,000 ft. The resulting deposit densities are presented in detail. The variations of deposit density with distance downwind from the source were obtained for the areas of heaviest deposit. These observed values were compared with those predicted by simple models. A model including dispersion due only to differential terminal velocity of different size beads gave poor results. Models incorporating, in addition, crude estimates of the diffusive effect of the vertical component of atmospheric turbulence gave more satisfactory results, although there were discrepancies in some trials. These discrepancies suggest the desirability of investigation into the effects of appreciable terminal velocity upon atmospheric diffusive spread of particulate clouds. Author

N64-26173 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
ENGINEERING TEST OF X-BAND MASER FOR WEATHER RADAR SET AN/MPS-34
Raymond L. Robbiani Mar. 1964 34 p
(USAELRDL-TR-2427; AD-602141)

An engineering test was performed to determine the increase in sensitivity that an X-band helium maser could afford a Radar Set AN/MPS-34. The maser increased sensitivity by 12.5 db. Radar sensitivity improvement suggests many prospects for future uses in nuclear-weather surveillance. These include improved meteorological intelligence and satellite operations. Future plans are explored. Photographs show a comparison in storm detection of Radar Set AN/MPS-34 with and without maser amplification. Author

N64-26174 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
AN EVALUATION OF TIROS VIII METEOROLOGICAL DATA FOR ARMY APPLICATIONS
William J. Richards Mar. 1964 20 p
(USAELRDL-TR-2439; AD-602140)

Experience gained with the Tiros VIII Automatic Picture-Taking (APT) System is described, and results are evaluated in terms of meteorological requirements of the field army. It is concluded that, despite certain limitations in the first experimental version, the APT system offers a valuable addition to the Army's meteorological facilities. Author

N64-26275 Los Alamos Scientific Lab., N. Mex.
SOURCE MEASUREMENT: DETERMINING THE RELEASE FROM A POINT SOURCE BY REMOTELY LOCATED SAMPLERS
Richard W. Henderson 17 Jul. 1964 21 p ref
(Contract W-7405-ENG-36)
(LA-3094) OTS: $0.50

The effluent from some chemical and nuclear processes may be offensive or constitute a health hazard. Proper control requires a knowledge of the source characteristics. Often, measurement of the source cannot be accomplished by a direct technique. By employing a distant, circular sampling array, Sutton's equation can be modified for the calculation of the release from any such inaccessible point source. A second method for approximating the strength of radioactive clouds using gamma intensity rate detectors is also given. Author

N64-26317 Travelers Research Center, Inc., Hartford, Conn.
THE INFLUENCE OF LOCAL WINDS ON FALLOUT Progress Report, 1 Jul.–31 Dec. 1963
Pieter J. Feteris, Edwin Kessler, III, and Edward A. Newburg [1964] 46 p refs
(Contract DA-36-039-AMC-03283(E))
(Rept.-1; AD-600447)

Model local circulations are discussed with regard to their influence on the disposition of airborne particles in a nonprecipitating, nondiffusive atmosphere. Two-dimensional vertical circulations, like the sea breeze along a straight coast, or like the circulations near mountain ranges, when steady state, principally affect the time of establishment of a pattern and not its shape or the ultimate patterns of the total accumulations at the ground. When such calculations intensify or decay during the passage of fallout through them, both the duration and onset time of fallout at ground locations can be affected, with associated local changes of total accumulation. Three-dimensional local circulations affect the place of deposit of airborne particles and the time of their deposition. Circulations confined to the horizontal plane can affect the place of deposit and the shape of a fallout pattern, but vertical air currents must occur to change the time of its establishment. Three-dimensional divergence accompanying vertical currents in the real compressible atmosphere significantly increases local concentrations in only those cases where updrafts are about equal to particle fall speeds; in such cases, the role of diffusion should be simultaneously considered. The influence of local circulations, in any case, is greatest with respect to the smallest (slowest falling) particles. Author

N64-26318 Air Weather Service, Washington, D.C. 4th Weather Group
WEATHER SUPPORT: EMERGENCY MISSION SUPPORT SYSTEM 482L
Robert F. Long 1 May 1964 37 p
(Rept.-4WGP-105-15-1; AD-440107)

The Emergency Mission Support System will consist of air-transportable traffic control, communications, and navigational aid equipment. A description of the system and of its operation is presented. The effect of the natural aerospace environment on the system is described. The meteorological support requirements for the system are identified and discussed. N.E.A.

N64-26359* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
TERRESTRIAL ENVIRONMENT (CLIMATIC) CRITERIA GUIDELINES FOR USE IN SPACE VEHICLE DEVELOPMENT, 1964 REVISION
Glenn E. Daniels, ed. 13 Mar. 1964 104 p refs
(NASA-TM-X-53023) OTS: $9.10 ph

This document provides guidelines on probable climatic extremes and probabilities-of-occurrence of terrestrial environmental data specifically for space vehicle and associated equipment development. The geographic areas encompassed are the Atlantic Missile Range (Cape Kennedy, Florida); Huntsville, Alabama; New Orleans, Louisiana; the Pacific Missile Range (Point Mugu, California); Sacramento, California; Wallops Test Range, (Wallops Island, Virginia); White Sands Missile Range, New Mexico; and intermediate transportation areas. Therefore, this document omits climatic extremes for worldwide operational conditions. This is consistent with the existing philosophy regarding the employment of large space vehicles, since launching and test areas are relatively restricted due to the availability of facilities and real estate. Author

N64-26402* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PROBLEMS OF ATMOSPHERIC WIND INPUTS FOR MISSILE AND SPACE VEHICLE DESIGN
James R. Scoggins and William W. Vaughan Repr. from J. of Spacecraft and Rockets, v. 1, no. 2, Mar.–Apr. 1964 p 181–184 refs
(NASA-RP-237)

Three basic types of wind inputs are discussed—samples of measured profiles, statistical distributions, and discrete profiles. The application and interpretation of these inputs for the design of vehicle structures and control systems require judgment on the part of the designer. Only two wind-profile measurement techniques even approach the desired accuracy and altitude resolution—photographic/smoke trail, and FPS-16 radar/spherical balloon. Larger quantities of accurate wind-input data and considerable study will be required to obtain accurate estimates of vehicle responses due to wind inputs. A critical analysis of techniques for employment of the wind-input data and interpretation of the vehicle response is needed; and the designer and meteorologist must work as a team to solve the wind input/vehicle response problem. Author

N64-26434 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS FROM METEOROLOGY AND HYDROLOGY, No. 3, 1964
13 May 1964 72 p refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 3, Mar. 1964
(JPRS-24-587; OTS-64-31253) OTS: $2.00

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N64-26435 Joint Publications Research Service, Washington, D.C.
WELL-REGULATED VERTICAL MOVEMENT OF THE AIR AND CLOUDINESS
Ye. G. Lomonosov and T. P. Popova *In its* Transl from Meteorology and Hydrol., no. 3, 1964 13 May 1964 p 10–19 refs (See N64-26434 18-21) OTS: $2.00

By means of the equations of statics, the vertical velocity in the atmosphere was determined as a function of the field of the altitudes of isobaric surfaces, z, and momentary variation of this field in time $\delta z/\delta t$. This equation gives little prognostic information about cloud cover. However, when there are well expressed descending movements in the free atmosphere, cloud cover, as a rule, is absent; the form and quantity of cloud cover can be reliably determined, in many cases, by the nature of the vertical movements. R.T.K.

N64-26436 Joint Publications Research Service, Washington, D.C.
TRANSPARENCY COEFFICIENTS OF AN IDEAL ATMOSPHERE AT DIFFERENT ALTITUDES AND THEIR USE FOR ESTIMATING THE TURBIDITY OF THE REAL ATMOSPHERE
M. S. Averkiyev and L. A. Ryazanova *In its* Transl. from Meteorology and Hydrol., no. 3, 1964 13 May 1964 p 20–25 refs (See N64-26434 18-21) OTS: $2.00

For the purpose of determining reliable magnitudes of the transparency coefficients of an ideal atmosphere, calculations were made of the intensity of solar radiation for an ideal (dry and pure) atmosphere. Allowances were made for the absorption of radiation by ozone and the permanent gases. The transparency coefficient of a real atmosphere may be represented as the product of the transparency coefficient of an ideal atmosphere and the transparency coefficient of the atmospheric impurities (water vapor and aerosols). The magnitude of the optic density of atmospheric turbidity was the most sensitive characteristic of the turbidity of the atmosphere and is therefore the most convenient index of atmospheric turbidity. R.T.K.

N64-26437 Joint Publications Research Service, Washington, D.C.
CALCULATION OF H_{500} MEAN VALUES OF SYNOPTIC PERIOD FROM FIRST-DAY DATA
M. N. Fedulova *In its* Transl. from Meteorology and Hydrol. 13 May 1964 p 26–32 refs (See N64-26434 18-21) OTS: $2.00

The operational use of weather forecasting maps for weather forecasting for a synoptic period is hampered by the fact that they are ready for use too late, that is, by the end of the second day of a period already begun. Therefore such maps may be used only for forecasting the rest of the synoptic period. To obtain maps for forecasting the entire synoptic period, an attempt is made to apply the principle proposed by Pagava to the construction of forecasting maps of AT_{500} for the current

synoptic period on the first day of that period. For this purpose, the assumption is made that for different forms of atmospheric circulation, the connections between the values of H_{500} of the first day and for the entire period will be essentially different. Work was performed to ascertain the nature of this connection in various macroprocesses. R.T.K.

N64-26438 Joint Publications Research Service, Washington, D.C.
SOME PROBLEMS OF THE SYNOPTIC METHOD OF LONG-RANGE WEATHER FORECASTING
V. G. Shishkov *In its* Transl. from Meteorology and Hydrol., no. 3, 1964 13 May 1964 p 33–43 refs (See N64-26434 18-21) OTS: $2.00

A method is proposed for long-range weather forecasting based on a comparison of the summary characteristics of the coincidences of zonal and meridional component currents, with respect to direction, on two maps of AT_{500}. P.V.E.

N64-26462 Weather Bureau, Washington, D.C. National Meteorological Center
SUMMARY OF VERIFICATION OF NUMERICAL OPERATIONAL TROPICAL CYCLONE FORECAST TRACKS FOR 1963
Lloyd W. Vanderman Feb. 1964 18 p
(TM-29; AD-438835)

Tables are presented showing numerical forecast models used in computing tropical cyclone tracks in 1963. The forecasts are compared with actual data, and the average error for the verified forecasts is indicated. P.V.E.

N64-26517 Geophysics Corp. of America, Bedford, Mass.
THEORETICAL AND OBSERVATIONAL STUDIES OF VORTEX CLOUD PATTERNS Final Report
Wen Tang, Edward M. Brooks, and Bruce F. Watson Jan. 1964 141 p refs
(Contract Cwb-10626)
(GCA-TR-64-Z-G; AD-600069)

The orientation, width, and spacing of the synoptic scale cloud bands in selected extratropical and tropical cyclones are related to meteorological parameters such as the horizontal and vertical variations of the wind. Several characteristic cloud band systems are associated with each vortex. The approximate wind direction at cloud-top level is normal to the bands near the vortex center, oblique to the outer bands, and parallel to the smaller bands in the sector. A model is developed to account for the mechanics of cloud band evolution. This simple model explains a number of observed characteristics of vortex cloud band systems, including the above relationship between flow and band orientation. A simple three-dimensional theory concerning cloud formation and band patterns in hurricanes and in occluded extratropical cyclones is developed. The theory reveals the general cloud patterns in hurricanes—the rotating spiral band, the cirrus clouds radiating out from the center, and the cloud pattern inside the eye—and the cloud band in the inner core of an occlusion. These findings agree very well with the characteristics of cloud bands in these cases. Author

N64-26574 Naval Weapons Lab., Dahlgren, Va. Computation and Analysis Lab.
CLIMATOLOGICAL DENSITY DATA FOR FORTY EURASIAN STATIONS
Myrtle D. France 23 Mar. 1964 228 p refs
(NWL-1909; AD-439290)

Seasonal climatological density data for 40 Eurasian stations, together with monthly climatological density data for 3 of the 40 stations, are presented in this report. Tabulations of means, standard deviations, and correlation coefficients by geometric altitudes from surface to 20,643 meters are given. These tabulations are based on statistical data obtained from observations extending over approximately 5 years. For purposes of description, graphical presentations of typical data are given for selected cases. Author

N64-26663 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
VERTICAL MOTION IN THUNDERCLOUDS [VERTIKAL'NYE DVIZHENIYA V GROZOVYKH OBLAKAKH]
N. Z. Pinus London, Min. of Aviation, Feb. 1964 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 150, no. 4, 1963 p 788–790
(RAE-TRANS-1058)

The vertical component of turbulence in cumulonimbus clouds was measured using simply instrumented aircraft equipped with radar. The distributions of R.M.S's (maximum 23 ft sec^{-1}), turbulence scales, and mixing coefficients are given. The definition of the last two coefficients is given but is different from the generally accepted one. Author

N64-26694 Canada Dept. of Transport, Toronto Meteorological Branch
THE DIABATIC CONTRIBUTION TO THICKNESS TENDENCY
E. C. Jarvis 25 May 1964 16 p refs
(CIR-4042; TEC-521)

Important diabatic processes occurring in the atmosphere are briefly discussed, and their contribution to thickness change is calculated for selected stations on the North Atlantic Ocean during a 7 day winter period. Results are compared with the diabatic thickness change determined by evaluating the terms in the thickness tendency equation. Although measurement errors are appreciable, values obtained by the two methods were comparable when the data were suitably smoothed. The results indicate the flux of sensible heat and water vapor can be used to evaluate the diabatic contribution to thickness tendency when cold air advection is occurring over the sea. Author

N64-26783* National Aeronautics and Space Administration, Washington, D.C.
THE VORTEX STRUCTURE OF THE CLOUD COVER ACCORDING TO WEATHER SATELLITE DATE [VIKHREVAYA STRUKTURA OBLACHNOSTI DO DANNYM METEOROLOGICHESKIKH SPUTNIKOV]
L. S. Minina Aug. 1964 15 p refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no 1, 1964 p 12-22
(NASA-TT-F-206) OTS: $0.50

This article presents a comparison of the data on the vortex structure of cloud cover, based on the observations of weather satellites and the observations made by a network of weather stations. Ground-surface weather maps, pressure-field topography maps, radiosondes, and the recording of the sources of atmospheric disturbances were used for a comparative analysis. Author

N64-26875 Oslo U., Blindern (Norway) Inst. of Theoretical Meteorology
A METHOD OF BALANCING INITIAL DATA FOR A MATERIAL-LAYER MODEL OF THE ATMOSPHERE Technical Note No. 6
Arnt Eliassen and Arne Grammeltvedt 9 Mar. 1964 13 p refs
(Contract AF 61(052)-525)
(AFCRL-64-506; AD-603041)

A method of balancing the initial wind field for a channel model with two material layers is described. The method is based on the requirements that the first and second local derivatives of pressure vanish initially. Author

N64-26949 Litton Systems, Inc., Minneapolis, Minn. Applied Science Div.
500-KC ELECTROMAGNETIC NOISE PULSE MEASUREMENTS OF SELECTED VERTICALLY CONVECTING CLOUD DEVELOPMENT Final Report
Douglas A. Kohl 28 Feb. 1964 244 p refs
(Contract AF 19(628)-2781)
(AFCRL-64-333; AD-603032)

Ground-based, 500-kc/s narrow band detection measurements were made of radiated electrical noise produced in cumuliform cloud developments selected for cooperative study during the 1963 (NSSP) National Severe Storms Project. The 500-kc data obtained with three different kinds of instruments are presented along with relevant condensations of weather station data, storm data, photographic data, 10-cm weather radar data, and penetration aircraft pilot report data. Although analysis using aircraft instrumentation data was not completed, an intimate relation between 500-kc sferics and convective cloud activity is apparent. The formation of a sferics pulse amplitude distribution index, which proved to be related to the rapidity of vertical cloud growth, strongly suggests a proportionality to airmass instability. The sferics pulse count rate was related to storm intensity and the total number of pulses proportional to storm size. Adjacent storms were observed, on occasion, to remain distinctly different throughout their life cycles as measured by sferics and other descriptors. Finally, storm complexes ocassionally existed in a steady state for long periods while continuously displaying both large radar reflectivities and electrification. Author

N64-26951 Geophysics Corp., of America, Bedford, Mass.
PRESSURE AND DENSITY SCALE HEIGHTS DEFINING ATMOSPHERIC MODELS Scientific Report No. 5
Raymond A. Minzner Apr. 1964 53 p refs
(Contract AF 19(628)-1633)
(GCA-TR-64-6-A; AFCRL-64-400; AD-602497)

Pressure scale height, density scale height, and their vertical gradients, all defined in terms of geopotential altitude, are compared and related. Constant vertical gradients of both geopotential pressure scale height and geopotential density scale height exist simultaneously. This situation leads to simply related equivalent expressions for both pressure ratio and density ratio versus geopotential height in terms of the geopotential gradients of either pressure or density scale height. These equations involve series expansions, that, for many applications, may be truncated after the first term, which is unity. The errors introduced into the pressure and density ratios by such truncation are considered. Simultaneously constant vertical gradients of the geometric versions of both pressure and density scale height are physically impossible. The implication of this situation on equations for pressure and density ratios in terms of geometric altitude and constant gradients of the geometric forms of pressure and density scale height are considered. Author

22 NAVIGATION AND GUIDANCE

Includes autopilots; star tracking; inertial platforms; and air traffic control. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; 20 Mathematics; and 29 Space Sciences.

N64-25916 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
ON GUIDANCE ERRORS INDUCED BY THRUST DECAY IN VERTICAL POWERED FLIGHT OF ROCKETS
Chong-Hung Zee and Samuel Suh Oct. 1963 19 p refs
(ADN-06-06-63.2)

Based on the characteristics of thrust decay after engine shutoff, analytical expressions for estimating guidance errors induced by thrust decay in vertical powered flight of rockets are derived by the direct series substitution technique. Accuracies of the resulting guidance errors are obtained with the aid of a "better estimate of errors." A numerical example is presented to show the effect of guidance errors as a result of different characteristics of thrust decay. Finally, the corresponding cases in which the guidance errors are computed by assuming an equivalent impulsive thrust at the end of the powered flight are investigated. Author

N64-26106 Aerospace Corp., El Segundo, Calif. Electronics Div.
SUMMARY OF ATHENA GUIDANCE AND CONTROL
Richard M. Allman 10 Jun. 1964 39 p refs
(Contract AF 04(695)-269)
(BSD-TDR-64-70; TDR-269(4810-31)-3; AD-443110)

This report is intended to serve as a brief technical summary of Athena guidance and control. It contains descriptions of the vehicle and mission, the attitude control system, the guidance system, guidance and control error analyses, and independent attitude reference systems. Numerous references are included in which more detailed information can be obtained. Author

N64-26107 Aerospace Corp., El Segundo, Calif. Electronics Div.
THE COMBINED AERODYNAMIC-PROPULSIVE ORBITAL PLANE-CHANGE MANEUVER
Richard W. Bruce 10 Jun. 1964 41 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-98; TDR-269(4550-10)-9; AD-602669)

Because the orbital plane-change maneuver is expensive when it is done by impulsive thrust, other techniques were sought that would be more economical from the standpoint of required characteristic velocity. Two techniques that use combined aerodynamic and propulsive forces were proposed by London and Nyland. These are reviewed, and their limitations, due in part to certain simplifying assumptions made in their analyses, are presented. This investigation demonstrates that both analyses, while valuable because they are presented in closed form, are limited to plane changes below 30° to 40°. The combined maneuver is superior to the impulsive-thrust plane change for vehicles with lift-to-drag ratios greater than 1.5, and the velocity savings that result as a consequence of using such maneuvers are on the order of 4,000 to 5,000 ft/sec, at most. For certain situations, the combined aerodynamic-propulsive maneuver is an attractive and available means for reducing the characteristic velocity requirement of the orbital plane change. Author

N64-26261 Radio Technical Commission for Aeronautics, Washington, D.C.
AIR TRAFFIC SYSTEM. CURRENT AIR TRAFFIC CONTROL PROBLEMS AND RECOMMENDED IMPROVEMENT PROGRAMS
25 Jun. 1963 86 p ref Prepared by Special Comm. 104
(RTCA-SC-104) Available from RTCA Sectretar., RM. 1072, Bldg. T-5, 15th and Constitution Ave., N.W., Washington, D.C.: $1.25

This report is a detailed presentation of problems and recommendations affecting all segments of aviation. The report is presented in two parts. Part I deals with broad operational and economic problems, or aspects of today's air-traffic system taken as a whole, and places emphasis on areas requiring future coordination and planning. Part II defines specific air-traffic-control problems currently being experienced and contains recommendations for immediate improvement programs. N.E.A.

N64-26396 Joint Publications Research Service, Washington, D.C.
ON ERRORS IN INERTIAL NAVIGATION SYSTEMS
V. D. Andreyev *In its* Tech. Cybernetics 19 Jun. 1964 p 242–265 refs (See N64-26376 18-16) OTS: $4.00

Error equations have been derived for the definition of stability and accuracy operations in inertial navigation systems. The equations are a reduction product of differential equations that give an analysis of the disturbed motions of the systems, moving parts. The expressions are directly based on the vertical and horizontal gyroplatforms' angles-of-inclination. A.L.B.

N64-26834 Federal Aviation Agency, Atlantic City, N.J. Systems Research and Development Service
SIMULATOR COMPARISON OF NETHERLANDS LANDING ZONE LIGHTING PATTERNS Final Report
Robert K. Mc Kelvey, Guy S. Brown, and Robert J. Ontiveros Feb. 1964 77 p refs Prepared for Netherlands Aero and Astronautical Res. Inst.
(FAA-ARDS-472)
(RD-64-25)

As a part of an exchange of equipment and services in airport lighting research programs, a comparison was made of touchdown zone lighting configurations of interest to the Dutch Government. The experiment was conducted in a flight simulator with a visual landing attachment. Systems compared differed primarily in the use of aiming point identifiers and longitudinal vs lateral arrays in the landing zone. The results confirm the role of the aiming point identifier in controlling precision of longitudinal positioning at touchdown, but warn against possible ambiguity of information if sufficiently distinctive pattern characteristics are not used to distinguish between successive elements of the approach and landing zone systems. Author

N64-26950 Bendix Corp., Teterboro, N.J. Eclipse-Pioneer Div.
ANALOG COMPUTER STUDY OF SAFE LOW APPROACH DECISION REGIONS AND EFFECTIVENESS OF GLIDE PATH EXTENSION TECHNIQUES, PHASE III Final Report
A. Friedman 31 Mar. 1964 71 p refs
(Contract FAA-ARDS-451)

This report presents the results of analog computer studies of three aspects of ILS-based all-weather landing systems; determination of minimum manual go-around altitudes under various conditions of winds and available thrust; determination of the range of initial aircraft positions and velocities from which a pilot can make a safe landing after completing a low approach; and evaluation of four glide slope extension techniques to discover if the employment of these techniques permits a relaxation of the tolerable course path bend amplitudes of the ILS signals. These studies were performed for the Boeing 707/320B and Caravelle series 10-R aircraft. Author

23 PHYSICS, GENERAL

Includes acoustics; cyrogenics; and optics. *For astrophysics see*: 05 Astronomy and Astrophysics. *For related information see*: 12 Geophysics; 29 Space Sciences; 24 Physics, Plasma; and 25 Physics, Solid-State.

N64-25838 Florida U., Gainesville
THE NUCLEAR PROPERTIES OF RHENIUM Final Technical Report, Addendum
E. E. Menge, W. H. Ellis, R. A. Karam, and T. F. Parkinson Dec. 1963 15 p refs
(Contract NOAS-60-6021-C)
(AD-439807)

The energy and intensity of the capture gamma transitions of natural rhenium were determined with a NaI(Tl) scintillation detector using a neutron-gamma beam from the thermal column of the University of Florida Training Reactor. The results obtained agreed well with those reported by other experimenters who used different techniques. Author

N64-25862 Illinois U., Urbana Coordinated Science Lab.
SPIN RELAXATION OF OPTICALLY PUMPED CESIUM
Frank A. Franz Apr. 1964 99 p refs
(Contract DA-36-039-AMC-02208(E))
(R-202; AD-439436)

Spin relaxation of optically pumped cesium vapor has been measured as a function of buffer gas pressure for various inert gases. Disorientation cross sections have been found to be 5.3×10^{-24} cm^2 for neon, 8.0×10^{-23} cm^2 for argon, 2.1×10^{-21} cm^2 for krypton, and 4.6×10^{-20} cm^2 for xenon. The diffusion coefficients of cesium in neon and argon were found to be 0.40 cm^2/sec and 0.23 cm^2/secm, respectively. Disorientation cross sections and diffusion coefficients have also been determined for molecular nitrogen. The results are $\sigma = 4.7 \times 10^{-23}$ cm^2, $D_0 = 0.22$ cm^2/sec for $N_2{}^{14}$; $\sigma = 5.3 \times 10^{-23}$ cm^2, and $D_0 = 0.20$ cm^2/sec for $N_2{}^{15}$. The agreement of these values with existing theory is discussed. Author

N64-25867* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PROBABILITY OF HYDROGEN IONIZATION BY ELECTRON IMPACT [O VEROYATNOSTI IONIZATSII VODORODA ELEKTRONNYM UDAROM]
V. A. Bronshten 17 Jun. 1964 5 p refs Transl. into ENGLISH from Astron. Zh., v. 41, no. 2, 1964 p 416–418
(NASA-TT-F-8911; ST-SP-10157)

A comparison is made of the empirical expressions for the ionization cross sections and the formulas for the coefficient of ionization by electron impact using experimental data given. A formula is given for the best representation of the experimental cross sections for electron energies $E < 100$ ev and another formula for $E > 100$ ev. The ionization coefficients are represented by formulas with the same precision; however the result obtained from one formula is slightly too high, and that from the other, too low. Author

N64-25873 Wisconsin U., Madison Theoretical Chemical Inst.
AN EQUATION OF STATE OF GASES AT HIGH TEMPERATURES AND DENSITIES
J. S. Rowlinson Repr. from Mol. Phys., v. 7, no. 4, 1964 p 349–361 refs
(Grant NsG-275-62(4180))

An equation-of-state is obtained in closed form for a gas composed of molecules with Lennard–Jones $(n,1/2n)$ potentials. It is useful at temperatures above about 12 (ϵ/k), where $\rightarrow\epsilon$ is the minimum energy of interaction and at all densities at which the equilibrium state is a fluid. It is derived by summing over all the cluster integrals of the virial expansion that occur in the approximation for the pair distribution function proposed by Percus and Yevick. Each cluster integral is represented correctly to terms of the order of n^{-1}. The equation agrees well with machine calculations of the pressure of dense gases for $n = \infty$ and $n = 12$, with static measurements of the compression of gases at high reduced temperatures, and with some preliminary measurements of the density of argon compressed by shockwaves to pressures in the range 100 to 200 kb. Author

N64-25881* Wisconsin U., Madison Theoretical Chemistry Inst.
THREE-DIMENSIONAL ADDITION THEOREM FOR ARBITRARY FUNCTIONS INVOLVING EXPANSIONS IN SPHERICAL HARMONICS
R. A. Sack Repr. from J. of Math. Phys., v. 5, no. 2, Feb. 1964 10 p refs
(Grant NsG-275-62(4180); Contract Nonr-2121(01))

For any vector $r = r_1 + r_2$ an expansion is derived for the product of a power r^N of its magnitude and a surface spherical harmonic $Y_L^M(\vartheta, \phi)$ of its polar angles in terms of spherical harmonics of the angles (ϑ_1, ϕ_1) and (ϑ_2, ϕ_2). The radial factors satisfy simple differential equations; their solutions can be expressed in terms of hypergeometric functions of the variable $(r</r>)^2$, and the leading coefficients by means of Gaunt's coefficients or $3j$ symbols. A number of linear transformations and three-term recurrence relations between the radial function are derived; but in contrast to the case $L = 0$, no generally valid expressions symmetric in r_1 and r_2 could be found. By interpreting the terms operationally, an expansion is derived for the product of $Y_L^M(\vartheta, \phi)$ and an arbitrary function $f(r)$. The radial factors are expansions in derivatives of $f(r>)$; for spherical waves, they factorize into Bessel functions of r_1 and r_2 in agreement with the expansion by Friedman and Russek. The $3j$ symbols are briefly discussed in an unnormalized form; the new coefficients are integers, satisfying a simple recurrence relation through which they can be arranged on a five-dimensional generalization of Pascal's triangle. Author

N64-25922 Grumman Aircraft Engineering Corp., Bethpage, N.Y. Nuclear and Radiation Physics Section
THEORETICAL ASPECTS OF NEUTRON ACTIVATION OF STRUCTURES
A. J. Favale, M. D. D'Agostino, and M. L. Rossi Feb. 1964 44 p refs
(RM-227)

This memorandum is concerned with the major theoretical aspects that must be considered before the neutron activation properties of structures (nuclear reactors for space flight) can be determined. Factors considered are the irradiation schedule of the reactor, the derivation of neutron activity due to cyclic and noncyclic irradiation, the geometry of the facility housing the reactor, and chain disintegrations. Also, recommended procedures for neutron cross-section calculations, in the energy regions $E < 0.0$ Mev and $E > 0.1$ Mev, are described. I.v.L.

N64-25945 Naval Air Development Center, Johnsville, Pa. Anti-Submarine Warfare Lab.
SPIN ECHOES IN MAGNETIC RESONANCE Foundational Research Program Phase Report
G. Thomas Moore 17 Apr. 1964 35 p refs
(NADC-AW-6332; AD-600275)

This report reviews the general theory of nuclear magnetic resonance with particular emphasis on the theory, methods, and techniques of pulsed resonance systems. Descriptions are given of the response of nuclear spins to 1, 2, 3, and multipulse arrays relating each to the mathematical development of E. L. Hahn. Included are oscilloscope pictures of typical examples of the various pulse and echo arrangements illustrating their use in measuring relaxation times (spin–spin and spin–lattice). Author

N64-25952 Office of Naval Research, Washington, D.C.
PHOTOCONDUCTIVITY OF GALLIUN ANTIMONIDE
M. A. Habegger and H. Y. Fan 1 Jun. 1964 153 p refs
(Contract Nonr-1100(04))
(AD-600178)

The photoconductivity of GaSb was studied to obtain information about impurity or defect levels and to elucidate the recombination processes of excess carriers. The spectral distribution, the steady-state magnitude of the response, and the transient behavior of the photoconductive signal were studied. Measurements were made in the temperature range of 5° to 370° K. Author

N64-25954 California Inst. of Tech., Pasadena Dynamics Lab.
GENERAL THEORY OF VIBRATION OF DAMPED LINEAR DYNAMIC SYSTEMS
T. K. Caughey and M. E. J. O'Kelly Jun. 1963 113 p refs
Supported by Esso Educational Foundation

A discussion is presented of how matrix analysis may be used to reduce matrices to either diagonal or Jordan form. Problems solvable in N-space are presented. This class of problems includes the type of problems analyzed by Rayleigh, Whittaker, and other mathematicians of the late 19th century. The problems that cannot be solved in N-space are discussed. The problem of perturbations of the damping matrix of lumped parameter systems is analyzed. The main practical use of this type of analysis is in calculating the approximate effect on the frequency and mode shapes of a system when the damping matrix is slightly changed. The question of stability of these systems is examined. R.T.K.

N64-25995 Rochester U., N.Y.
SOME CONSEQUENCES OF OCTET DOMINANCE MODEL
A. H. Zimerman, Riazuddin, and S. Okvbo 1 Jun. 1964 17 p refs
(Contract AT(30-1)-875)
(UR-875-35)

Consequences based upon the tadpole diagram were investigated. Especially the decays $\omega \rightarrow 2\pi$, $K^+ \rightarrow 2\pi$, and the mass difference between K_2^0 and K_1^0 were computed. Author

N64-25996 SFD Labs., Inc., Union, N.J.
AXIALLY EXTENDED INTERACTION AREA INVERTED COAXIAL MAGNETRON Final Report, Feb. 1962–Feb. 1963
P. Du Fossé and F. A. Feulner Wright-Patterson AFB, Ohio. Res. and Technol. Div., Oct. 1963 64 p refs
(Contract AF 33(657)-8290)
(Rept.-20-F; RTD-TDR-63-4074; AD-600722)

This report describes the effort directed toward high power generation at millimeter wave frequencies. Axially extended interaction in an ICEM coaxial magnetron was the means employed toward attaining this goal. The work was performed at 35 Gc. The ICEM coaxial magnetron, which is an extension of the CEM coaxial magnetron principle, increases the number

of resonators possible and hence the power generation capabilities of the CEM coaxial magnetron. The axially extended interaction approach to high power generation further increases the power generation capabilities by increasing the number of resonators by a factor of two or more. The mode control problems associated with the TE_{011} mode cavity used in a single-stage ICEM coaxial magnetron had already been solved. However, in a two-stage tube employing two sets of vane resonators, a method of mode selection was required that would allow one to operate in a particular TE_{01n} mode and yet inhibit operation in the $TE_{01(n\pm1)}$ mode of a particular cavity. Several special hybrid test vehicles were employed to study this problem. Author

N64-26011 Massachusetts Inst. of Tech., Cambridge Engineering Projects Lab.
VOID FRACTION MEASUREMENT
D. William Gouse, Jr. Apr. 1964 88 p refs
(Contract Nonr-1841(73))
(DSR 8734-2; AD-600574)

One hundred and thirty-nine references on various methods of void fraction and film thickness measurement were reviewed and indexed by subject. Since the radioactive particle attenuation techniques were the most frequently employed method for measuring void fraction, these techniques were studied in detail. The conclusion of this detailed study is that accurate measurements of void fraction are feasible when small diameter, low and mono-energetic photon beams are employed. Such requirements generally will exclude the use of radioisotope gamma-ray sources but will not exclude radioisotope beta-ray sources. Much of the published void fraction data using radioactive isotope sources are in error by ± 10% or more. Author

N64-26024* Columbia U., New York, N.Y. Radiation Lab.
OBSERVATIONS ON THE (1s2s2p) $^4P_{5/2}$ METASTABLE STATE IN LITHIUM
P. Feldman and R. Novick Repr. from Proc. of the 3rd Intern. Conf. on the Phys. of Electron. and Atomic Collisions, London, 22–26 Jul. 1963 p 201–210 refs
(Grant NsG-360)

The (1s2s2p) ^4P configuration in He^- and Li is metastable against radiation and autoionization via the Coulomb interaction. Lithium atoms in this state can be produced by exchange excitation (energy = 56cv) of ground state Li atoms. Experimentally, a neutral lithium beam with low energy electrons was bombarded, and ions resulting from the decay of metastable atoms 3 cm from the source were collected. The excitation function, production cross section ($\sigma \sim 10^{-19}$ cm^2), and the lifetime (τ = 5.1 ± 1μsec) were measured. A theoretical estimate of the probability of autoionization resulting from the spin–spin interaction gives a lifetime of 16 sec. Author

N64-26032 Technical Research Group, Inc., Melville, N.Y.
RADIATION OF SOUND FROM A CIRCULAR DISK WITH A UNIFORM PRESSURE DISTRIBUTION
Visvaldis Mangulis Apr. 1964 27 p refs
(Contract Nonr-4385(00))
(TRG-142-TN-64-2; AD-439374)

The velocity potential for a flexible circular disk with a uniform pressure distribution in an infinite rigid planar baffle is calculated. The problem is mathematically similar to the diffraction of a plane wave by a circular aperture. The velocity of the disk that produces the uniform pressure becomes infinite at the edge of the disk. The mixed boundary value problem is solved by expanding the velocity of the piston in an infinite Dini series of Bessel functions; to find the coefficients in the series one has to solve an infinite set of linear equations. For numerical computations the infinite set is approximated by a finite set of equations. Numerical results for the sound pressure in the far field and the near field, the radiation impedance, and the velocity distribution over the piston are presented. The cavitation limited power output from the constant pressure disk exceeds the output from a disk with a constant velocity. Author

N64-26034 Polytechnic Inst. of Brooklyn, N.Y. Physics Dept.
MEAN FREE PATH AND BOUNDARY INFLUENCES IN THE METALLIC FIELD EFFECT Technical Report
H. J. Juretschke 1 Jun. 1964 17 p refs
(Contract Nonr-839(37))
(TR-13; AD-600681)

The change in surface conductance due to the metallic field effect was calculated for various simple thin film models that take into account that the penetration depth of applied fields in metals is very small, and that mean-free-path effects are important in the very thin films in which the field effect is observable. Comparison with experiments of the behavior to be expected due to effective changes in surface scattering, surface charge density, or film thickness shows that the latter mechanism seems to be predominant. Predictions of this model regarding the magnitude of the field effect are given. Author

N64-26039* National Aeronautics and Space Administration, Washington, D.C.
INVESTIGATION OF THE INSTABILITY OF A POSITIVE COLUMN IN AN AXIAL MAGNETIC FIELD
A. R. Akhmedow and A. A. Zaytsev Jul. 1964 13 p refs
Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III, Fiz.-Astron. (Moscow), no. 1, Jan.–Feb. 1964 p 3–10
(NASA-TT-F-218) $0.50

The results of measurements of the critical magnetic field in relation to the development of a corkscrew instability in a positive column in a longitudinal magnetic field in the presence of a high-frequency electric field are presented. Data are also presented on the effect of the length of the plasma column on the critical magnetic field. Author

N64-26041 Johns Hopkins U., Baltimore, Md. Carlyle Barton Lab.
ZERO-CROSSING INTERVALS OF RAYLEIGH PROCESSES
A. J. Rainal May 1964 68 p refs
(Contract AF 33(657)-11029)
(TR-AF-108; AD-600393)

This report presents experimental results concerning probabilities and probability densities defined by the zero-crossing points of the envelope of a sine wave plus a gaussian process. It is shown that these probabilities and probability densities are similar to the corresponding probabilities and probability densities defined by an associated gaussian process. At present none of the probabilities or probability densities can be derived explicitly by analytical methods. The standard deviations associated with the probability densities are also presented. The first moments associated with the probability densities are compared with exact theoretical values. All other experimental results are compared with theoretical approximations. Probabilities and probability densities defined by the mathematical stationary points of the envelope of a sine wave plus a gaussian process are also investigated. Author

N64-26045 Battelle Inst., Frankfurt am Main (W. Germany).
MICROGRAVIMETRIC INVESTIGATION INTO THE MECHANISMS OF CORROSION OF REACTOR MATERIALS IN THE PRESENCE OF NUCLEAR RADIATION
W. Kuhn and G. Walter Brussels, EURATOM, Apr. 1964 25 p refs
(Contract Euratom-071-61-12-RDD)
(EURAEC-874; EUR-1474.e) Available from Belgian Am. Bank and Trust Co., N.Y., Account No. 121.86: 50 Belg. Fr.

The corrosion kinetics of pure iron, 18/8 stainless steel, and zirconium were investigated by microgravimetry in the presence and in the absence of β-radiation. Corroding atmospheres were oxygen and water vapor at pressures below 1 atmosphere. The radiation source was Sr-90-Y-90, 30 curie; the absorbed dose rate amounted to approximately 10^5 rad/h. No significant difference in corrosion kinetics was observed with and without radiation. With pure iron in oxygen at room temperature the corrosion rate was less than $1.5° \ 10^{-9}$ g/cm^{2}h. At 260° C with pure iron, stainless steel, and zirconium in oxygen and water vapor the corrosion proceeds according to the equation $g = A° \ t^n$ where g = weight gain, A = a constant, t = time, the exponent n ranging between 0.5 and 0.3. The corrosion mechanism of iron at intermediate temperatures (about 200° C) seems to differ from that at high temperatures (eg., 800° C) and low temperatures (room temperature and below). Also in a few discontinuous experiments at a radiation dose rate of about 10^6 rad/h (pure iron and zirconium at 260° C, 1 atm O_2 and 15-mm Hg H_2O), no radiation effect was observed.
Author

N64-26046 Laboratoire de Physique Theorique et des Hautes Energies Orsay (France)
RELATIVISTIC STUDY OF THE REACTION $p + p \rightarrow d + W^+$
M. Le Bellac, F. M. Renard, D. Schiff, and J. Tran Thanh Van Jun. 1964 10 p refs
(TH-56)

An impulse approximation, depicted by a neutron exchange diagram designating the four momenta, is given for the two-body process reaction $p + p \rightarrow d + W$. The cross section for this reaction is calculated within this approximation, and thus the meson exchange contributions are neglected. Calculations were performed of the differential and total cross sections for several W masses from 700 Mev to 1,600 Mev and of different forms for the n-p-d functions tested in the photodisintegration process. Also, the influence of the following effects on the size of the W meson is discussed: deutrium structure, derivative coupling, and weak-interaction nucleon-form factors. I.v.L.

N64-26050 Aberdeen Proving Ground, Md. Ballistic Research Labs.
NEUTRON REFLECTION AND FLUX VERSUS DEPTH FOR ALUMINUM WITH AN APPENDIX NEUTRON DOSE TRANSMISSION VERSUS THICKNESS
Frank J. Allen, Arnold T. Futterer, and William P. Wright Feb. 1964 104 p refs
(BRL-1238; AD-439641)

Detailed calculated results of neutron reflection and flux versus depth for aluminum are given in the form of machine printouts. The angular and energy distributions of the reflected neutrons along with the energy-dependent and total flux at various depths are contained in tabular form on the printouts. Neutron number current, number flux, and dose transmission, as functions of thickness, are also given in tabular form on the printouts. A table of summary information on reflection is presented. This contains number current, number flux, dose, and energy reflection factors as functions of incident energy and angle. A few figures are presented to illustrate graphically the various tabular results. The dose transmission results as a function of incident angle and slab thickness for the various incident energies are included. Author

N64-26067 European Atomic Energy Community, Brussels (Belgium)
INELASTIC SCATTERING OF COLD NEUTRONS MEASURED ON VANADIUMHYDRIDE [INELASTISCHE STREUUNG KALTER NEUTRON AN VANADIUMHYDRID]
R. Rubin, W. Kley and J. Peretti Joint Nuclear Res. Center, Ispra Establishment (Italy), Mar. 1964 15 p refs Presented at the Neutron Physics Conf., Karlsruhe, Germany, 8–10 Oct. 1963 in GERMAN
(EUR-522.d) Available from Belgian American Bank and Trust Co., N.Y., Account No. 121.86: 40 Belg. Fr.

The inelastic scattering of neutrons was measured on vanadium hydride of varying H-concentrations and at different temperatures. The spectra show the localized oscillation states of hydrogen in vanadium hydride. In the α-phase, the peak energy distribution stands at 118 mev and in the α- + β phase, at 48 mev. At very low energies, the intensity rises in inverse proportion to the energy, which is not described by a DEBYE spectrum. Author

N64-26073* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
SUPERCONDUCTING-TO-NORMALLY CONDUCTING TRANSITIONS IN STRIP TRANSMISSION LINE STRUCTURES
A. R. Sass and F. J. Friedlaender (Purdue U.) Repr. from J. Appl. Phys., v. 35, no. 5, May 1964 p 1494–1500 refs
(NASA-RP-244)

A theoretical and experimental investigation of superconducting-to-normally conducting transitions in strip transmission line structures is presented. The theoretical analysis is based on a macroscopic model, which is the transmission line analog of the Pippard model. It is assumed that during the transition a superconducting–normally conducting (S–N) interface propagates along the transmission line structure. This situation is treated theoretically as a moving boundary value problem. The S–N interface propagation velocity is determined explicitly in terms of the current that induces the transition, the operating temperature, and the superconductive penetration depth. Experimental results indicate that the model is useful for predicting the transition time of a strip transmission line structure. Author

N64-26098 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France)
UNITARY SYMMETRY AND WEAK INTERACTIONS
M. Gourdin (Paris U.) May 1964 29 p refs Presented at the Colloq. on Theoret. Physics, Bordeaux

A general discussion is presented of the currents (electromagnetic and weak) and the unitary symmetry encountered in weak interactions. Also discussed are these processes: (1) leptonic—leptonic decay of pseudoscalar mesons and baryons, and high-energy neutrino reactions; and (2) nonleptonic—the nonleptonic Hamiltonian, Kaon $\rightarrow$pion pion disintegration, nonleptonic decay of baryons, and radiative weak decays of baryons. P.V.E.

N64-26114 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PROBLEMS IN HIGH-TEMPERATURE PHYSICS

V. A. Kirillin 14 May 1964 11 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), v. 33, no. 2, 1963 p 38–43
(FTD-TT-64-295/1; AD-602338)

Problems connected with research in the following areas are discussed: the thermophysical properties, heat transfer, and physicochemical process in liquid metals and their vapors; the thermophysical properties and heat transfer in gases at high temperatures; the thermophysical properties, heat transfer, and physicochemical process in solids (construction materials); and thermophysical processes in high-temperature constructions and apparatus. A solution to these problems is essential to the development of a nuclear power unit for space flight and to the development of a plasma generator for the direct conversion of heat into electrical energy. I.v.L.

N64-26115 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ENERGY SPECTRA OF ELECTRONS DETACHABLE IN THE PHOTOIONIZATION OF MOLECULES
F. I. Vilesov and B. L. Kiurbatov 14 May 1964 pp p refs
Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Fiz. (Moscow), v. 27, no. 8, 1963 p 1088–1093
(FTD-TT-64-296/1+2; AD-602342)

The distribution of photoionization electrons, according to their kinetic energies was investigated by a retarding field method. Data derived include these: (1) voltampere curves of the photoionization electron flow in naphthalene vapors; and (2) energy spectra of the electrons of aniline, naphthalene, and m-xylene. Also discussed are the energy spectra of the electrons of methylaniline, dimethylaniline, and benzene.
I.v.L.

N64-26162 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
SOURCE OF PROTONS WITH THERMAL DISSOCIATION OF HYDROGEN MOLECULES
M. D. Gabovich and Z. P. Fedorus 10 Jun. 1964 14 p refs
Transl. into ENGLISH from Ukr. Fiz. Zh. (Ukraine), v. 1, no. 2, 1956 p 158–169
(FTD-TT-64-522/1+2; AD-442440)

A proton source was developed with a high proton content in an ion beam resulting from the thermal dissociation of hydrogen molecules. The source-construction is of the magnetic type in which the discharge takes place in a chamber at temperatures of 2,200° to 2,400° K. The utilization of such a source may be profitable when it becomes necessary to produce atomic ions from gas molecules or ions of high-melting metals. I.v.L.

N64-26165 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
SELECTION AND PRIMARY FOCUSING OF IONS IN A SOURCE OF MULTIDISCHARGE IONS
F. I. Mineyev and O. F. Kovpik 18 Jun. 1964 11 p refs Transl. into ENGLISH from Zh. Tekhn. Fiz. (Moscow), v. 33, no. 12, 1963 p 1444–1448
(FTD-TT-64-541/1+2+4; AD-602373)

Report is given on the effective use of plasma focusing when selecting ions from a pulse source of multiply charged ions (pulse length 200μsec, repetition rate 2 cps). Gaseous nitrogen was admitted into the source. With optimum selection of the parameters of discharge in the source, potential of the extracting electrode and the geometry of the source gap, the extracting electrode received a 300-ma pulse current of heavy ions accelerated to 35 kv. Half of this current consists of nitrogen ions, the balance of ions of elements making up the material from which the ion source is constructed. The presence of N_{14}^{+3}—17 ma, N_{14}^{+2}—54 ma, N_{14}^{+} —42 ma, F_{19}^{+2}—30 ma, F_{19}^{+2}—20 ma, etc. ions was established in the spectrum. Author

N64-26176 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
BETA-EUCRYPTITE-COATED EMITTER STUDY
S. Levy Apr. 1964 15 p refs
(USAELRDL-TR-2479; AD-602454)

Lithium aluminosilicate, when heated from 1,000° to 1,350° C, emits lithium ions from its surface. This study evaluates beta (lithium aluminosilicate) eucryptite as an ion-emitting source. Coated refractory emitters have demonstrated on ion-emitter work function of 2.12 V with a corresponding Richardson A value of 8.4 $(10)^{-3}$ amps/cm^2 °K^2. Author

N64-26177 New Mexico U., Albuquerque
MEASUREMENT OF CONTINUOUS X-RAY SPECTRA USING AN ABSORPTION METHOD
Harold D. Southward Kirtland AFB, N. Mex., AF Weapons Lab., Jun. 1964 55 p refs
(Contract AF 29(601)-5976; ARPA Order 307-62)
(AFWL-TDR-64-36; AD-442596)

Continuous X-ray spectra have been calculated from X-ray transmission data in the energy range from 180 kvp to 600 kvp. The method proved to be satisfactory for the output of both flash X-ray and d.c. X-ray machines. A NaI (Tℓ) crystal was used to detect the portion of a well-collimated X-ray beam that was transmitted through various thicknesses of copper absorber. In the flash X-ray data, the intensity of the X-ray beam was normalized with the output of a scintillation detector. The method of analysis is basically that described by Greening and others. Basic improvements in the experimental system consist of procedures to insure dose-rate independence of the measuring system. Accurate empirical fits to the X-ray transmission data were made. The experimental data points deviate from the empirical curve 1% to 3%. Author

N64-26208 New Mexico U., Albuquerque
A MONTE CARLO CODE FOR TRANSIENT RADIATION EFFECTS
W. J. Byatt and Dale M. Sparks Kirtland AFB, N. Mex. AFSP, Jun. 1964 26 p refs
(Contract AF 29(601)-5976)
(AFWL-TDR-64-37; AD-442597)

Experimental findings on the behavior of resistors and capacitors under transient gamma irradiation can be interpreted in terms of radiation-induced changes in conductivity. Since the conductivity and the associated transient currents observed are proportional to the number density of free electrons generated, the calculation of the latter quantity is of interest. A Monte Carlo code has been written that describes time-dependent photon transport within finite pieces of material and is valid in either plane or spherical geometry at present. The extension to cylindrical coordinates is trivial. The interactions undergone by the photons are assumed to be either the photoelectric effect or Compton scattering. The energy of the ejected electrons is recorded as photon histories are traced, and the way in which electrons subsequently behave is discussed approximately. A complete description of the code is given, together with a discussion of preliminary numerical results. Author

N64-26211 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

ENERGY SPECTRA OF IONS SCATTERED BY POLYCRYSTALLINE SURFACES OVER SMALL ANGLES

V. A. Molchanov and V. Soshka 18 Jun. 1964 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 155, no. 1, 1964 p 70–71

(FTD-TT-64-543/1+2+4; AD-602349)

The energy spectra of reflected ions are studied, using the classical laws of conservation of energy and momentum. The dependency of the energy spectra on the scattering angle is shown by the fact that the change in the form of the spectrum proceeds gradually in proportion to the increase in the scattering angle. J.L.D.

N64-26215 General Telephone and Electronics Labs., Inc., Bayside, N.Y.

STUDY OF ADSORPTION OF GASES ON SOLIDS IN THE HIGH VACUUM RANGE Scientific Report No. 7

J. V. Florio 30 Apr. 1964 10 p refs

(Contract AF 19(628)-331)

(TR-64-255.7; AFCRL-64-468; AD-602489)

Measurements of the adsorption of nitrogen on a polycrystalline tungsten wire and of carbon monoxide on molybdenum were continued. The saturation coverage of nitrogen on tungsten at room temperature was shown to be a function of the steady-state pressure and varies from 1×10^{14} to 2.5×10^{14} molecules/cm^2 over the pressure range 10^{-9} to 10^{-6} torr. The adsorption of carbon monoxide on molybdenum at room temperature increases the work function of molybdenum over its initial value by 0.1 to 0.2 ev at saturation. Author

N64-26221 New Mexico U., Albuquerque

TRANSIENT RADIATION EFFECTS ON HALL DEVICES

Le Roy Meyer, Harold Cates, and W. W. Grannemann Kirtland AFB, N. Mex. AFSP, Jun. 1964 48 p refs

(Contract AF 29(601)-5976; ARPA Order 307-62)

(AFWL-TDR-64-38; AD-442579)

A review of the basic theory of Hall effect and Hall effect devices as related to transient radiation effects is presented. The theory predicts that any transient effect in the Hall voltage output during gamma irradiation of the device depends on the type of biasing used. There is no change in Hall voltage output for constant voltage bias, but the Hall voltage varies as a function of $1/n$ for constant current bias, and as a function of $|_3 1/\sqrt{n}|$ for constant power bias where n is the number of free electrons/cm^3 in the material. The transient radiation effects are small and usually within the noise level for dose rates up to 10^7 r/sec. Some experimental data were obtained using AFWL 600-kv flash X-ray and WSMR 8-Mev Linac that support the theory. Bothe thin film and crystal devices were used. The thin film devices have a wider range of frequency response and are more radiation resistant. Author

N64-26234* Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

SOURCE OF HIGH-INTENSITY PROTONS

R. A. Demirkhanov, Yu. V. Kursanov, and V. M. Blagoveshchenskiy 10 Jul. 1964 10 p refs Transl. into ENGLISH from Pribory i Tekhn. Eksperim. (USSR), no. 1, 1964 p 30–33

(FTD-TT-64-586/1+2+4; AD-602740)

An ion source with a 1.5-a proton emission current is described. The results of investigating the emission properties of the source and the pulse operating regime are given. Author

N64-26251* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

NONADIABATIC THEORY OF INELASTIC ELECTRON-HYDROGEN SCATTERING

H. L. Kyle and A. Temkin Repr. from the Phys. Review, v. 134, no. 3A, 4 May 1964 p 600–607 refs

(NASA-RP-269)

The nonadiabatic theory is applied to the inelastic S-wave scattering of low-energy electrons from atomic hydrogen. The zeroth-order (angle-independent) approximation for excitation of the 2s level from the ground state is described by the same equation used to describe elastic scattering below the 2s threshold, but with more complicated boundary conditions. The solution was effected by expanding the wave function in terms of separable solutions. With the assumption of reciprocity it is also possible to obtain the 2s–2s cross sections. The elastic (1s–1s) cross sections are within 1% of the close-coupling results in the triplet case, but are about 20% greater in the singlet case. The inelastic (1s–2s) cross sections are reduced about 20% in the triplet case and 20% to 40% in the singlet case, relative to the close-coupling results. Author

N64-26262 Rochester U., N.Y.

MASS RENORMALIZATION IN QUANTUM FIELD THEORY

C. R. Hagen 1 Jun. 1964 7 p refs

(Contract AT(30-1)-875)

(UR-875-40)

This note points out that, while δm can be nonzero for certain field theories, there is no compelling reason to expect this result in the general case. To this end, an example is given of a perfectly well-defined field theory in which δm vanishes for a finite mass fermion, independently of the value of Z_2. The model considered is a special case of a spin one-half version of Zachariasen's model. I.v.L.

N64-26265 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France)

TRILINEAR COUPLINGS FORBIDDEN BY NONET SYMMETRY FOR VECTOR MESONS

J. J. Sakurai (Chicago U.) Jun. 1964 8 p refs for Presentation at the Intern. Conf. on Phys. of High Energy Particles, Dubna (USSR)

(TH-60)

It is demonstrated that nay symmetry that makes the degeneracy of the vector singlet and the vector octet nonaccidental forbids a number of trilinear couplings that not only are known to exist but are also known to play vital roles in high-energy inelastic processes. It is also shown that for the validity of the mass relations:

$$m^2(\rho) = m^2(\omega)$$
$$m^2(\rho) + m^2(\phi) = 2\,m^2(K^*),$$

which are satisfied rather well and give a value of the $\omega\,\phi$ mixing angle λ:

$$\lambda = \cos^{-1}(2/3)^{1/2},$$

it is essential that the SU(3) invariant interactions that violate nonet symmetry are much weaker than the SU(3) violating interactions responsible for the mass differences among the vector mesons. R.T.K.

N64-26270* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

VECTORIAL REFLECTANCE OF THE EXPLORER IX SATELLITE MATERIAL

Gerald M. Keating and James A. Mullins Washington, NASA, Aug. 1964 47 p refs

(NASA-TN-D-2388) OTS: $1.25

Reflectance measurements were made at different azimuth and colatitude angles relative to flat samples of the aluminum and white epoxy paint surfaces used on the Explorer IX satellite, by means of an adapted monoplanar goniophotometer. Contour charts of the reflectance from these samples were obtained from the results of these measurements. Reflectance relative to mutually perpendicular axes was obtained by graphical integration of the contour charts. The vectorial summation of the reflectance was thus obtained. The aluminum sample was essentially a specular reflector, and the white epoxy paint sample was essentially a diffuse reflector. Author

N64-26280 Whirlpool Corp., St. Joseph, Mich.
THERMOELECTRIC TEMPERATURE CONTROL IN AN/URQ-9 FREQUENCY STANDARD Interim Development Report 1 Jan.–31 Mar. 1964
A. L. Wennerberg 15 Apr. 1964 25 p refs
(Contract NObsr-85314)
(IDR-12; AD-437196)

Frequency measurements made on five low-temperature 5-mc crystals are plotted to show their frequency stabilization period and long-term aging characteristics. Long-term drift rates of precision oscillators coupled to the low-temperature crystals were within several parts in 10^{-11} per day. Performance of the five oscillators after periods of shutdown are reported. The oscillators exhibited shifts in frequency upon startup that ranged between 5×10^{-10} to 112×10^{-10} low. The units demonstrated a short stabilization period of a few hours and then went into a new aging curve. Author

N64-26291 Warnecke Electron Tubes, Inc., Des Plaines, Ill.
STUDY OF INTERACTION STRUCTURES LEADING TO DEVELOPMENT OF X-BAND CROSSED-FIELD AMPLIFIER 3rd Quarterly Progress Report, 28 Dec. 1963–28 Mar. 1964
24 Apr. 1964 23 p
(Contract NObsr-89504)
(AD-437747)

The purpose of this study is to obtain delay lines for an X-band crossed-field amplifier, having a delay ratio of 20 in the center of the band, to insure the attainment of the necessary 7-to-11-kmcs bandwidth. The current status includes the following: (1) An S-band fenced line was constructed on a ceramic by photoforming techniques having a delay ration of 20 and a pitch about three times smaller than the initial photoformed lines. The dispersive characteristics of this line have been measured, and tests to determine its other characteristics are continuing. In addition, construction of an X-band line scaled from the S-band has been started, using photoforming techniques. (2) A method of coupling the line to the input and output waveguide was formulated. Also, a means of cooling the line has been devised, and measurements of its power-dissipation capacity will be possible, using the X-band models. (3) Techniques were improved for constructing the ceramic lines by photoforming and for measuring the heat-transfer characteristics of these ceramic (sapphire and aluminum oxide) lines in models of the cooling system envisioned for the crossed-field amplifier tube. I.v.L.

N64-26298 Library of Congress, Washington, D.C. Aerospace Technology Div.
MAGNETIC FIELD PRODUCTION; COMPREHENSIVE REPORT Surveys of Soviet-Bloc Scientific and Technical Literature
20 Jul. 1964 84 p refs
(ATD-P-64-46)

Subjects covered include pulsed field production, continuous field magnets, analysis of mechanical stresses in coils, superconductivity, magnetic fields in plasma and fusion physics, and magnetic fields in particle physics. The principal conclusion is that Russian scientists seem to rely heavily on the promises proffered by superconductivity, to the neglect of conventional methods of high-field production. A list of nearly 260 references is included. D.E.W.

N64-26303 Oak Ridge National Lab., Tenn.
GAS-COOLED REACTOR PROGRAM SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING MARCH 31, 1964
W. D. Manly Jul. 1964 396 p refs
(Contract W-7404-ENG-26)
(ORNL-3619) OTS: $5.00

The following are discussed: (1) investigations in support of the experimental gas-cooled reactor—performance analysis, component development and testing, irradiation testing of components and materials; and (2) advanced reactor design and development—fueled-graphite development, investigations of fueled-graphite systems, clad fuel development, investigation of moderator materials, the German pebble-bed reactor, studies of advanced systems, experimental investigations of heat transfer and fluid flow, and facilities and equipment. R.T.K.

N64-26349* Case Inst. of Tech., Cleveland, Ohio
EXPERIMENTAL NEUTRON FLUX DISTRIBUTIONS IN A WATER SYSTEM WITH AN INTERNAL CAVITY Final Report
Floro Miraldi, David Mc Bride, and George W. Nelson 30 Jun. 1964 73 p refs
(Contract NAS3-3213)
(NASA-CR-54110) OTS: $7.60 ph

Experimental neutron flux distributions were measured in a water-filled tank containing a 27-in. diam. spherical cavity region. Neutrons were provided by a plutonium–beryllium neutron source located at the center of the cavity, and bare and cadmium-covered indium foils were used to determine the neutron flux distributions in both the cavity and moderator regions. Three separate cavity systems were examined including the simple cavity, a concentric sphere system with a 9-in. diam. interior sphere, and a concentric sphere system with a 12-in diam. interior sphere. Foil activation distributions and thermal neutron flux distributions are presented for the several cavity cases examined. These included cavity fillings of boron trifluoride gas to simulate a uranium hexafluoride gas-filled cavity. Author

N64-26366* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.
BARYON STAR MODELS
Cullen L. Inman [1964] 20 p refs Submitted for Publication
(NASA-TM-X-51815) OTS: $1.60 ph

In the framework of general relativity, large masses consisting of identical baryons whose mass is taken to be that of the neutron are considered. Four assumptions are made as to their interactions, leading to four equations of state, and for each, the masses and radii of a number of configurations are calculated, for various values of the central number density. The relation of the mass to a parameter for the four equations of state are strikingly similar. Author

N64-26386 Joint Publications Research Service, Washington, D.C.
THE PASSAGE OF RANDOM SIGNALS THROUGH A LINEAR DYNAMIC SYSTEM WITH DISTRIBUTED PARAMETERS
A. G. Senin *In its* Tech. Cybernetics 19 Jun. 1964 p 124–130 refs (See N64-26376 18-16) OTS: $4.00

The problems are investigated of conversion of correlation functions and spectral densities of random fixed processes by dynamic systems with distributed parameters. The solution of the problem is given under various boundary conditions. Author

N64-26408* Rochester U., N.Y. Inst. of Optics
A COMPACT RADIAL SHEARING INTERFEROMETER BASED ON THE LAW OF REFRACTION
M. V. R. K. Murty Repr. from Appl. Optics, v. 3, Jul. 1964 p 853–857 refs Presented at the Fall Meeting of the Opt. Soc. of Am., Chicago, Oct. 1963
(Contract NASR-14)

A brief review of radial shearing interferometers as well as a logical development of various types of these interferometers is presented. The discussion considers two types of interferometers. One type essentially introduces a radial shear in collimated light; in the other type a radial shear is introduced in converging light. Finally, a compact interferometer is described. This interferometer uses the Snell's law of refraction for obtaining radial shear and consists of two identical prisms that make up a pentaprism. In one of the prisms, a hemispherical depression is made, and this is the basic element that introduces radial shear. Author

N64-26410 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 89
Shih Ya-feng et al 10 June 1964 33 p refs Transl. into ENGLISH of Articles from Chinese Periodicals
(JPRS-25016; OTS-64-31451) OTS: $1.00

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4. CONFERENCE ON FLUID MECHANICS Li Yu-ch'ang p 29–30

N64-26413* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
FORCES ACTING ON BUBBLES IN NUCLEATE BOILING UNDER NORMAL AND REDUCED GRAVITY CONDITIONS
Edward G. Keshock and Robert Siegel Washington, NASA, Aug. 1964 26 p refs
(NASA-TN-D-2299) Film supplement to this report is available of loan from Lewis Research Center

An experimental study was made of bubble dynamics for saturated nucleate boiling in aqueous-sucrose solutions in normal- and reduced-gravity fields. Results are compared with a previous study that used distilled water. Departure diameters of bubbles in sucrose solutions were gravity independent, whereas bubbles in distilled water were gravity dependent. Calculations based on the experimental data showed bubble departure in sucrose solutions to be dominated by inertial forces (gravity independent), while bubbles in water were buoyancy dominated (gravity dependent). The rise of bubbles after departure was also observed and analyzed. Author

N64-26424 RAND Corp., Santa Monica, Calif.
THE THEORY OF BRANCHING PROCESSES
Theodore E. Harris May 1964 243 p refs
(Contract AF 49(638)-700; Proj. RAND)
(R-381-PR; AD-440338)

A systematic development of the theory of branching processes is presented, along with brief descriptions of the more important applications. The following are discussed: (1) the Galton–Watson branching process; (2) processes with a finite number of types; (3) the general branching process; (4) neutron branching processes (one-group theory, isotropic case); (5) Markov branching processes (continuous time); (6) age-dependent branching processes; and (7) branching processes in the theory of cosmic rays (electron–photon cascades). R.T.K.

N64-26432 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France)
THE ONE-PARTICLE EXCHANGE APPROXIMATION AND FEYNMAN GRAPHS
Bernard Diu and Jean-Loup Gervais (Centre de Phys. Theorique de L'ecole Polytech., Paris) Jun. 1964 17 p refs
(TH-57)

In a scalar model, the one-particle exchange approximaP tion with elastic unitarity on the right-hand cut is not equivalent to summing a series of Feynman graphs. The convergence properties of the N/D integrals is studied in the case of vector meson exchange between two spinless particles—it appears that, although the interaction is not renormalizable, a single subtraction is sufficient to give finite results at any order in the coupling constant. Author

N64-26449 Rochester U., N.Y.
THE INTERMEDIATE BOSON — UNITARY TRIPLET OR OCTET?
C. Ryan, S. Okubo, and R. E. Marshak 5 Jun. 1964 13 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-36)

Within the framework of unitary symmetry, two possible versions are discussed of a weak intermediate vector boson theory corresponding to a triplet and an octet model, respectively. The former has the advantage that it affords the basis for a possible explanation of the large mass of the intermediate boson in terms of strong interactions; it also requires the use of the full U_3 group and not simply its SU_3 subgroup. The latter can be accommodated within the existing SU_3 octet scheme. Both versions lead to the same effective four-fermion interaction for normal weak processes but may be distinguished by observation of the production cross sections and decay modes of the intermediate bosons. Author

N64-26454 Princeton U., N.J. Plasma Physics Lab.
A MASS SPECTROMETER ANALYSIS OF THE PLASMA IN THE DIVERTER OF THE C-STELLARATOR
A. Gibson, A. S. Bishop, E. Hinnov, and F. W. Hofmann Apr. 1964 16 p refs
(Contract AT(30-1)-1238)
(MATT-261)

A mass spectrometer was inserted within the C-stellarator divertor for the purpose of analyzing the composition of those particles that are peeled off the main body of the plasma and enter the divertor chamber. The mass spectrometer is described in detail. The way in which impurity concentrations are determined from the signals observed at the spectrometer is presented; and how the mass spectrometer collector, on which the ion strikes, provides a crude indication of the energy of the ions parallel to field lines at the mass spectrometer is discussed. R.T.K.

N64-26484 Atomics International, Canoga Park, Calif.
SNAP REACTOR HANDBOOK—TRANSIENT ANALYSIS
W. A. Rhoades and W. B. Green 15 Jul. 1964 41 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9368) OTS: $1.00

This report presents some of the problems involved in the kinetics of uncontrolled power transients in SNAP reactors, and some of the techniques available for solving them. The report includes a review of space-independent kinetics equations for bare and reflected reactors, the more important feedback effects present in SNAP reactors, analytical solutions to the equations applicable in certain special cases, and a review of the computer codes available for solution of the equations in the general case. Author

N64-26524 Northrop Corp., Newbury Park, Calif. Ventura Div.
THE EFFECT OF SMALL IRREGULARITIES ON ELECTROMAGNETIC SCATTERING FROM AN INTERFACE OF ARBITRARY SHAPE
K. M. Mitzner 15 May 1964 43 p refs
(NVR-3503; AD-600543)

A perturbation analysis is used to determine the effect of small irregularities on electromagnetic scattering from an interface between two media. The interface irregularities are replaced by approximate equivalent surface currents, and the field in space can then be found using the dyadic Green's function of the unperturbed problem. The approach is valid when the irregularity has small slope and small amplitude compared to the wavelengths and local radii of curvature. To facilitate applications, the theory of dyadic Green's functions is developed, and the necessary functions are given for some important geometries. Author

N64-26526 Dewey (G.C.) Corp., New York, N.Y.
AN EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF RADIATION ON THE PROPAGATION OF ELECTROMAGNETIC SIGNALS IN AIR Second Quarterly Progress Report, 1 Oct.–31 Dec. 1963
M. N. Hirsh and P. N. Eisner 31 Dec. 1963 38 p refs
(Contract DA-36-039-AMC-03278(E))
(R-173-2; AD-439935)

Operational tests of the RF monopole mass spectrometer were performed. A description is given of the optical spectrometer, and the results of preliminary measurements obtained with it are presented. The results of electron loss frequency measurements in air-like N_2-O_2 mixtures in the pressure range from 2 to 10 torr are presented and discussed. R.T.K.

N64-26528 European Organization for Nuclear Research, Geneva (Switzerland)
DESIGN AND CONSTRUCTION OF A 100 KG d.c. MAGNET
P. G. Innocenti and M. Morpurgo 1 May 1964 15 p refs
(CERN-64-23)

A magnet for studying the properties of superconductors was designed and constructed. It can produce a field of 100 kg over a diameter of 6 cm. The magnet consists of 11 pancakes wound with a hollow copper conductor. Each pancake has 12 independent water circuits. Each coil turn of a pancake is obtained by brazing together, at one point, two identical spirals made of hollow copper piping with a rectangular cross section. Insulation is obtained, after having assembled all the turns of one pancake, by inserting epoxy-impregnated fiber glass between the turns. The 11 pancakes are clamped in an iron frame to insure proper mechanical performance and safety and to reduce the external stray field. I.v.L

N64-26529 European Organization for Nuclear Research, Geneva (Switzerland)
THE CREATION OF A MULTIPOLAR FIELD IN AN ELLIPTICAL VACUUM CHAMBER [LA CREATION DE CHAMPS MULTIPOLAIRES DANS UNE CHAMBRE A VIDE ELLIPTIQUE]
Y. Baconnier 27 May 1964 27 p refs In FRENCH
(CERN-64-24)

The problem of deflecting and focusing charged particles in a vacuum chamber is resolved by the use of magnets (dipoles) or of quadrupoles. These elements create, within the vacuum chamber, a constant magnetic field, linear or quadratic, according to whether a dipole or a quadrupole is used. This report calculates the flow-density distribution on the chamber in order to obtain the desired magnetic field. Two cases are considered: (1) The external medium of the chanber is of infinite permeability (iron). (2) The external medium of the chamber is of a μ 0 permeability (air). Dipoles, quadrupoles, and sextipoles are considered in deflecting and focusing the charged particles. Also, the case of the boundary layer of an infinitely slender flow is considered. However, the flow density in the interior of the boundary layer is not constant, and the described method of calculation is, therefore, rather impractical. I.v.L

N64-26532 General Electric Co., King of Prussia, Pa. Space Sciences Lab.
INVESTIGATION OF MAGNETICALLY INDUCED IONIZATION Semi-Annual Technical Summary Report, Nov. 1, 1963–Apr. 30, 1964
D. B. Zauderer [1964] 41 p refs
(Contract Nonr-3867(00))
(AD-600531)

Three modes of magnetically induced ionization were observed in xenon, depending on whether the initial conductivity was electron-atom or electron-ion collision dominated: (1) If the initial conductivity was greater than 300 mhos/m, electron-ion collisions dominated the conductivity. Due to the large coulomb cross section, the electron heating in the MHD generator resulted mainly in ohmic heating of the gas. (2) In addition, if the Lorentz forces were five times larger than the gas-dynamic force, additional conductivity increases due to magnetic compression were observed. (3) If the initial conductivity was less than 10 mhos/m, it was electron-atom collision dominated. With this initial conductivity at fields greater than 30,000 gauss, order-of-magnitude conductivity increases were observed, which were attributed to nonthermal electron heating and ionization. Also, a study on the effect of impurities on the ionization rate in xenon shock waves was undertaken. It was concluded that the achievement of nonthermal ionization in an MHD generator requires a small electron-atom collision cross section to minimize the ohmic heating of the gas, and that diatomic impurities in rare gases raise the ionization rate due to their low-lying excitation levels. I.v.L

N64-26533 Ohio State U. Research Foundation, Columbus Antenna Lab.
TABLES OF THE REGULAR AND LOGARITHMIC COULOMB WAVE FUNCTIONS AND TABLES OF ARG $\Gamma(l+i\eta)$
R. De Vore and Shen Lin Nov. 1963 130 p refs
(Contract AF 33(657)-10426)
(Rept.-1565-4; AD-600286)

The regular and logarithmic Coulomb wave functions were tabulated for an attractive potential from k=0.01 to k=1.00 in steps of 0.02 within the radial range $0.05 \leq r \leq 10.0$ for the first three angular momentum values. The argument of the gamma function $\Gamma(l+i\eta)$ was tabulated for the parameter l, $-3 \leq l \leq 4$, with η varying from -2.0 to $+30.0$. Author

N64-26546 Battelle Memorial Inst., Columbus, Ohio
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING APRIL, 1964
Russell W. Dayton and Ronald F. Dickerson 1 May 1964 59 p
(Contract W-7405-ENG-92)
(BMI-1669) OTS: $1.50

The current status of the following areas is discussed: (1) reactor materials and components (irradiation-surveillance program on type 347 stainless steel, the explosive welding of flat-plate and tubular sections of Zircaloy-2 to Inconel); (2) fuel studies; (3) the radiation-induced formation of organotin compounds; (4) coated-particle fuel materials (materials development, fuel irradiation, supporting research); (5) hydrofluorinator corrosion studies; (6) long-term creep–rupture program or sintered aluminum powder alloys and the mechanical properties of zirconium alloys; (7) fission-product deposition studies; and (8) the gas-cooled reactor program (encapsulation studies, irradiation examination of Hastelloy X cladding from AGN 1B8T-1 and -2 subassemblies, the evaluation of type 347 stainless steel for gas-cooled reactor applications). I.v.L.

N64-26558 European Organization For Nuclear Research, Geneva (Switzerland) Proton Synchrotron Machine Div.
MEASUREMENTS ON SLOW BEAM-EJECTION FROM THE CPS
C. Bovet, G. R. Lambertson (Lawrence Radiation Lab.), and K. H. Reich 3 Jun. 1964 38 p refs
(CERN-64-25)

Measurements were made of the ejected-beam burst controllability, as well as of the controllability of the jitter and ripple-structure of the ejected beam. Measurements of ejection efficiency, beam emittance, and background were also made. All measurements used a new resonant ejection scheme with the CERN proton synchrotron. It was expected that this scheme would give higher ejection efficiency and lower beam emittance than other systems used for proton synchrotrons. Partial success is reported. D.E.W.

N64-26565 Laboratoire de Physique Théorique et des Hautes Energies, Orsay (France)
GENERATION OF BARYONS AND RESONANCES IN BROKEN SU_3 SYMMETRY
B. Diu, H. R. Rubinstein, and J. L. Basdevant Jul. 1964 64 p refs
(TH-62)

The dynamical hypothesis of generation of particles one particle exchange graphs, which proved successful in early calculations, is analyzed in the case of baryonic amplitudes. A simple criterion that seems to work in the mesonic case is shown to be unapplicable. At this stage the main question of the paper is posed—which is the relation between higher symmetries and the analyticity point of view when breakdowns of the former are allowed? The generation of the resonance decuplet as performed by Martin and Wali can be understood both in terms of broken SU_3 and analyticity, though mixing between representations is rather strong. When the reciprocal bootstrap idea of generating baryons by decuplet exchange is tried, serious difficulties appear. A model is proposed that generates the baryons via vector meson exchange. It stands the proposed tests better than the reciprocal bootstrap model but is not completely free of difficulties. As a fundamental difference, it predicts a ninth baryon, which belongs to a singlet representation. Author

N64-26567 Geophysics Corp. of America, Bedford, Mass.
CALCULATIONS OF WAVE FUNCTIONS AND TRANSITION PROBABILITIES Final Report
Ali M. Naqvi and George A. Victor Kirtland AFB, N. Mex., AF Weapons Lab., Mar. 1964 629 p
(Contract AF 29(601)-5676; DASA-WEB-07.003)
(RTD-TDR-63-3118; AD-600374)

Analytic expressions for the Slater integrals F^k and G^k are derived using the screened hydrogenic orbitals. The Slater integrals in this form are functions of the principal and the orbital angular momentum quantum numbers of the two electrons, and also the scaled (or effective) nuclear charges for the two electrons. Expressions are also derived for the partial derivatives of the Slater integrals. The functional dependence of the Slater integrals and their partial derivative upon the quantum numbers and the scaled nuclear charges is partially separated, which makes it especially convenient to use them in a machine program for calculating the screening parameters. The Slater integrals and their partial derivatives are evaluated for numerous cases of interest (up to n = 9). The calculations of the screening parameters for many-electron atoms, based on Layzer's variational theory, are described. Total energies, excited-state energies, ionization potentials, spin-orbit integrals, and transition integrals were calculated for numerous atomic systems using screened hydrogenic orbitals. These calculations are compared with experimental and other theoretical results. Tables of scaled nuclear charges for isoelectronic sequences from Li I (3 electrons) to Cs I (55 electrons) are given. Author

N64-26587 European Organization For Nuclear Research, Geneva (Switzerland) Nuclear Physics Div.
CERN WORK ON WEAK INTERACTIONS
A. Zichichi 3 Jun. 1964 27 p refs Presented at the Roy. Soc., London, Feb. 1964
(CERN-64-26)

Investigations of the weak interactions concerned with the following areas are summarized: (1) validity of the universality of the Fermi interaction and of the conserved vector current hypothesis; (2) validity of the $(1 + \gamma)$ version of the universal Fermi interaction; (3) weak structure of the pion; (4) existence of the induced pseudoscalar coupling; and (5) neutrino physics—axial and vector form factors, possible existence of intermediate bosons, inelastic cross sections, neutrino-flip hypothesis, and neutral lepton currents. P.V.E.

N64-26594* Rensselaer Polytechnic Inst., Troy, N.Y.
EFFECTS OF HELIUM TEMPERATURE STRAIN ON THE SUPERCONDUCTING TRANSITION OF Pb-IN ALLOYS
J. F. Schenck, J. S. Willis, and R. W. Shaw [1964] 5 p refs Submitted for Publication
(Grant-NsG-100)
(NASA-CR-58135) OTS: $1.10 ph

The Pb–In alloy wires were plastically deformed under tension at helium temperatures. For various amounts of deformation, the resistive transition was measured in both longitudinal and transverse magnetic fields. Two major effects were observed: (1) In the transverse field, the resistance minimum previously noted in niobium and in transition metal alloys is induced and intensified by deformation; the deformation effect can be annealed at temperatures below 150° K, and (2) The current-carrying ability of the sample above H_{c2} is increased by deformation and also anneals at low temperatures. R.T.K.

N64-26598 Ohio State U. Research Foundation, Columbus Antenna Lab.
A STUDY OF ELECTRODYNAMICS OF MOVING MEDIA
C. T. Tai Repr. from Proc. of the IEEE, v. 52, no. 6, Jun. 1964 p 685–691 refs
(Grant NsG-448)

Presentation is made of a digest of Minkowski's theory of electrodynamics of moving media in the three-dimensional form. The invariant nature of the Maxwell–Minkowski equations is explained in terms of conventional electrodynamic language. The important role played by the constitutive relations in formulating a complete theory of electrodynamics of moving media is pointed out. A critical review of some current writings on the subject is also included. Author

N64-26601 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France)
COUPLING CONSTANTS IN BROKEN UNITARY SYMMETRY
B. Diu, H. R. Rubinstein, and J. L. Basdevant Jun. 1964 20 p refs
(TH-61)

A set of Yukawa coupling constants needed in analytic calculations of pseudoscalar meson–baryon amplitudes (including exchange of resonances, vector mesons, and baryons) is presented. Since in such calculations the existence of poles is very sensitive to the values of the crossed channel couplings, it is necessary to improve on exact unitary symmetry predictions, which give inaccurate ratios for a number of already known parameters. The coupling constants are calculated by taking into account first-order SU_3 violations, as already suggested by Muraskin and Glashow. The universality conditions of Sakurai are imposed on vector-meson couplings, which drastically reduces the number of parameters. The results are compared with the scanty experimental data, which, however, can provide tests of the first-order violation hypothesis. Author

N64-26603 Midwestern Universities Research Assn., Madison Wis.
RESONANT BEAM EXTRACTION IN FIXED FIELD ALTERNATING GRADIENT ACCELERATORS
Werner William Shoultz and C. L. Hammer (Iowa State U. of Sci. and Tech.) 2 Jan. 1963 36 p refs
(Contract AT(11-1)-384)
(MURA-666) OTS: $0.50

The resonant beam extraction method proposed by C. L. Hammer and L. J. Laslett for constant gradient and alternating gradient accelerators was extended to fixed field alternating gradient accelerators. It is possible to find field perturbations that are effective in causing the radial betatron oscillations to grow exponentially at a particular azimuthal position, and that at the same time have an effect upon the equilibrium orbit that greatly enhances ease of extraction. Digital calculations verifying the analytical predictions are presented. It remains necessary, however, to choose field perturbations that do not introduce nonlinear effects having unfavorable extraction characteristics. Author

N64-26604 European Organization for Nuclear Research, Geneva (Switzerland)
COULOMB SCATTERING IN A FOCUSING MEDIUM [DIFFUSION COULOMBIENNE EN MILIEU FOCALISANT]
J. Banaigs, A. Citron, J. Fronteau, and J. Hornsby 15 Jun. 1964 39 p refs In FRENCH
(CERN-64-29)

The FORTRAN programs B51 and B58 relative to the coloumb scattering in a focusing medium (a magnetic biconvergent lens), are described. The problem consists of a study of the intensity loss of a beam due to multiple electromagnetic scattering in a physical medium. Coloumb scattering alone, is considered; nuclear scattering is completely ignored. The programs, therefore, apply essentially to the μ component of secondary beams. Program B51 calculates the standard of deviation of coloumb scattering in the focusing medium, and program B58 calculates the transmission spectrum of a beam passsing through a diffuser. I.v.L

N64-26624 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
THE TORSIONAL DAMPING CAPACITY OF A THIN WIRE AND ITS APPLICATION TO THE DAMPING OF A LIBRATING EARTH SATELLITE
J. F. Smola, Paul R. Schrantz, and B. E. Tossman Aug. 1963 61 p refs
(Contract NOw-62-0604-c)
(CM-1039; AD-600182)

A method that was effectively used to damp a librating gravity gradient stabilized earth satellite is described. The device consists of an extremely weak beryllium–copper helical spring plated with cadmium; this is the primary damping medium. Some of the problems that confronted the experimenters during the development program are discussed, along with the numerous test data that were collected. Currently accepted theories describing the mechanism of energy dissipation investigated are enumerated and evaluated. Author

N64-26631 Atomics International, Canoga Park, Calif.
FISSION PRODUCT RELEASE FROM IRRADIATED URANIUM-ZIRCONIUM HYDRIDE SNAP FUEL
W. M. Cegelski 15 Jul. 1964 39 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9673) OTS: $0.75

A series of experiments were performed to determine the fission product release from SNAP 10A/2 uranium–zirconium hydride fuel samples at temperatures of 2,000° to 3500° F maintained for periods of 1 min to 8 hr. Author

N64-26657 Centre National de la Recherche Scientifique, Paris (France)
THE PERTURBATION OF SPECTRAL FREQUENCIES BY SOLID MATRICES Quarterly Technical Status Report No. 3, 1 Oct–31 Dec. 1963
B. Vodar [1963] 7 p
(Contract DA-91-591-EUC-2882)
(E-450-P; AD-437598)

This report contains an examination of the perturbation of spectral frequencies by solid matrices in the vacuum ultraviolet, a study of the absorption spectra of atomic species in the compressed matrix of a frozen rare gas—krypton in argon and xenon in argon, and a study of the possibility of investigating the L_α line of atomic hydrogen in solid matrices. I.v.L

N64-26684 Rochester U., N.Y.
ELECTROMAGNETIC MASS DIFFERENCES IN THE UNITARY SYMMETRY MODEL
Susumu Okubo 13 Mar. 1964 19 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-26)

Higher order effects due to both the electromagnetic and the SU(3)-violating interactions were investigated for masses of particles belonging to the octet and decouplet representations of the unitary symmetry. Author

N64-26685 Rochester U., N.Y.
TRIALITY TYPE AND ITS GENERALIZATION IN UNITARY SYMMETRY THEORIES
C. R. Hagen and A. J. Mac Farlane 20 Mar. 1964 22 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-27)

Within the context of an extension of the SU_3-symmetry theory recently suggested by Gell-Mann and further developed by the authors, certain aspects of the theory of the special unitary groups are examined. The plurality type of a given representation is introduced as the generalization of the triality concept to SU_{n+1} and is shown to be associated with a multiplicative conservation law. Theorems for the reduction of representations of SU_{n+1} are derived that are subsequently used to relate plurality type to the existence of fractional eigenvalues for the generator $Y_1^{(n)}$ of $U_1^{(n)}$ Author

N64-26686 Rochester U., N.Y.
BOUNDARY CONDITION MODEL, II: ANTIHYPERON-NUCLEON SCATTERING
Martin S. Spergel (Ph.D. Thesis) 27 Mar. 1964 28 p refs Submitted For Publication
(Contract AT(30-1)-875)
(UR-875-28)

The differential elastic cross sections, total elastic, charge exchange, and annihilation cross sections and polarization were calculated up to several hundred Mev for antihyperon-nucleon scattering. The model employed for the calculation uses an elastic one and two pion potential plus an absorptive core boundary condition. The elastic antihyperon-nucleon potential is constructed using SU3 group symmetries. Author

N64-26696 Sandia Corp., Albuquerque, N. Mex.
MEASUREMENTS FROM GRAVEL GERTIE TESTS
Maynard Cowan Jul. 1964 42 p ref
(SC-R-64-127) OTS: $1.00

Results of the second Nevada test of the AEC's special structure (Gravel Gertie) indicate that plutonium fallout within 3,000 ft of a burst within the structure is reduced to one-fourth the amount for a similar detonation in the open, when the burst occurs with the access door to the structure open. Contamination levels higher than 100 $\mu gm/m^2$ caused by detonation of 550 lb of high explosive could extend over one mile from the structure under the same conditions. Tracer material (uranium) used in the test escaped through the open entrance. Standard operating procedure for this structure calls for the door to be closed. Results of the third NTS test of the structure are summarized. They indicate that no external plutonium contamination would result from the detonation of 550 lb of high explosive with uranium as a tracer material within the main room when the entrance is closed by a blast-proof door. Author

N64-26702 Atomics International, Canoga Park, Calif.
NONDESTRUCTIVE DETERMINATION OF URANIUM-235 CONTENT OF SNAP FUEL RODS. VOLUME II: STATISTICAL METHODS FOR EVALUATING DATA OBTAINED FROM COUNTING EXPERIMENTS
M. A. Greenfield, C. T. Nelson, and R. L. Koontz 15 Jul. 1964 24 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9600) OTS: $0.50

This report describes a statistical method for evaluating the homogeneity of U^{235} in reactor fuel rods on the basis of measuring the characteristic radiation emitted by this uranium isotope. Included are applicable statistical tests, and analysis of data—determination of instrument fluctuations, homogeneity along a rod, and comparison of total uranium content in rods. R.T.K.

N64-26706* Geophysics Corp. of America, Bedford, Mass.
PLANETARY PHYSICS. V: AN EXPANSION METHOD FOR CALCULATING ATOMIC PROPERTIES. II: TRANSITION PROBABILITIES
M. Cohen and A. Dalgarno Washington, NASA, Aug. 1964 37 p refs
(Contract NASw-840; AF 29(601)-5225)
(NASA-CR-87) OTS: $1.00

An earlier expression for the expectation value of a single-electron operator that is stationary with respect to first-order variations of the state wave function was generalized to the case of an off-diagonal matrix element connecting two different states. Explicit calculations are carried out of the probabilities of dipole transitions between configurations $1s^a\ 2s^b\ 2p^c$ and $1s^a\ 2s^{-1}\ 2p^{c+1}$ for all members of the isoelectronic sequences from helium to neon, and the importance of taking into account the mixing of degenerate configurations is demonstrated. The accuracy is at least comparable to that of the Hartree–Fock approximation, and in cases where degeneracy is important, it is much superior. Author

N64-26718 Bendix Corp., Ann Arbor, Mich. Bendix Systems Div.
RADIATION EFFECTS PARAMETERS IN NAP APPLICATIONS Quarterly Progress Letter, Dec. 1963–Feb. 1964
17 Mar. 1964 8 p
(Contract AF 29(601)-5911)
(BSR-890; AD-439684)

The experimental test plan was revised with emphasis placed on the results of tests of transistors operated under uniform conditions in three distinct radiation environments—Co^{60} gamma radiation and two positions relative to the core of the 2-mw pool-type reactor. The high-frequency common emitter gain, h_{fe}, of each of the 140 transistor devices was measured at two operating points using a General Radio Tube 1607-A transfer-function and immittance bridge. The results of these measurements were used to select the divices for each radiation test. The instrumentation for measuring transistor h_{fe}, V_{ce}, and I_{cdo} were assembled and checked out. I.v.L.

N64-26737 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
NOTES ON THE DYNAMICS OF CARDAN SUSPENSION
D. M. Klimov 14 Jul. 1964 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 4, 1963 p 7–9
(FTD-TT-64-416/1+2+4; AD-602876)

The cause of free gyroscopic drift in a Cardan suspension during nutational oscillation was assumed to be the constant component of the projection of the moment of forces of the reaction in the fulcrums of the outer-ring axis on the mean direction of the axis of rotation of the inner ring. Moreover, it is well known that the motion of the gyroscopic axis is caused by the action forces of the inner ring on the rotor. Calculations carried out in this paper show that the moment of forces of action of the inner ring on the rotor and the moment of forces of the reactions of the base on the outer ring have different projections on the mean direction of the inner-ring axis. Here, it is proved that the constant components of these projections are mutually equal. Therefore, inaccurate mechanical arguments in certain problems yield an accurate result. Author

N64-26761 Aerospace Corp., El Segundo, Calif. Space Physics Lab.
A PHOTOELECTRIC ATLAS OF THE INTENSE LINES OF THE HYDROGEN MOLECULAR EMISSION SPECTRUM FROM 1025 TO 1650 A AT A RESOLUTION OF 0.10 A
K. E. Schubert and R. D. Hudson 4 Oct. 1963 36 p refs
(ATN-64(9233)-2; AD-422867)

A photoelectric atlas of the intense lines of the hydrogen molecular spectrum between 1,025 and 1,650 A is presented. The accuracy of identification is ±0.5 A between 1,100 and 1,650 A and ±0.10 A between 1,025 and 1,100 A. Author

N64-26766 Los Alamos Scientific Lab., N. Mex.
DELAYED NEUTRON REDUCED GROUPS BY LEAST SQUARES
Thomas E. Springer 24 Jul. 1964 21 p refs
(Contract W-7405-ENG-36)
(LA-3082) OTS: $0.50

This report describes a method of evaluating reduced group decay constants and abundances used in the reactor neutronic kinetic equations by a least-squares technique. The computed reduced parameters are presented for several different fissile species. A comparison of the neutron density time response for various reactivity steps is made between the various reduced groups for U^{235} fast fission. Author

N64-26791 Stanford U., Calif. Stanford Linear Accelerator Center
INVESTIGATIONS OF TRAVELING-WAVE SEPARATORS FOR THE STANFORD TWO-MILE LINEAR ACCELERATOR
O. A. Altenmueller, R. R. Larsen, and G. A. Loew Aug. 1963 52 p refs Presented at the 1963 Intern. Conf. on High Energy Accelerators, Dubna, USSR, 21–27 Aug. 1963
(Contract AT(04-3)-400)
(SLAC-17) OTS: $1.25

The investigations undertaken to design and test traveling-wave separators for a 2-mile linear accelerator are described. Attention is focused on the separation of particles that are bunched at production. Discussions are presented concerning theory and design optimization of RF separators, cold tests and fabrication of RF structure, and performance of RF separator models. R.T.K.

N64-26793 European Organization for Nuclear Research, Geneva (Switzerland)
REPORT ON THE FLOATING WIRE WORK
W. Hirt 20 Mar. 1964 25 p
(M-15)

The path followed by a charged particle moving with constant speed in a magnetic field was simulated by means of a current-carrying wire that was subjected to tension. This analogy was used to measure the following: (1) calibration of momentum versus magnet current at fixed bending angle for MA1; (2) determination of equivalent excitation currents in MC3 and MC4; and (3) measurement of momentum resolution and opening angle in the secondary beam. R.T.K.

N64-26810 Cornell U., Ithaca, N.Y.
FINAL STATES IN PHOTOIONIZATION Technical Report No. 4
E. J. Mc Guire Mar. 1964 39 p refs
(Contract DA-31-124-ARO(D)-43)
(AROD-2810-14; AD-443058)

In quantum mechanical calculations on atomic systems, the accuracy obtained depends on the type of matrix element under consideration. With matrix elements calculated for the ground state the Hartree–Fock wave function will usually give accurate results (to better than 10%). However, when the calculation involves matrix elements between the ground state and an excited state or between two excited states, the accuracy is limited by the fact that the excited state is less accurately known than the ground state. This is an unfortunate situation for photoionization work. This report describes a method for treating excited states of atoms involving interior electrons. The method satisfies both the Schrodinger equation and the boundary conditions without making the detail-obscuring choice of modified hydrogen wave functions. Author

N64-26853 New York U., N.Y. School of Engineering and Science
MOLECULAR FREQUENCY STANDARD PROJECT Final Report
Leon Esterowitz 24 Sep. 1963 111 p refs
(Contract Nonr-285(35))
(AD-431030)

The development of a molecular frequency standard based upon a molecular resonance line in the vicinity of 500 mc is presented, along with a study of spectral lines that hold promise of being good frequency standards in the above region. J.L.D.

N64-26868* New York U., N.Y.
LOW ENERGY SCATTERING OF ELECTRONS BY ATOMIC AND MOLECULAR SYSTEMS Final Report, Nov. 1, 1962-Oct. 31, 1963
Sidney Borowitz [1963] 3 p refs
(Grant NsG-336)
(NASA-CR-58052) OTS: $1.10 ph

A scattering spectrometer was built and used to measure the total absolute cross section for the scattering of electrons by argon, molecular oxygen, and nitrogen in the energy range from 1 to 25 electron volts. Results were slightly higher than those previously published. Charge transfer in near adiabatic collisions was investigated mathematically, and the scattering of electrons by atomic systems with a quadruple moment in the ground state was calculated. D.E.W.

N64-26872 Battelle Memorial Inst., Columbus, Ohio
FISSION-FRAGMENT-INDUCED DIMENSIONAL CHANGES IN PYROLYTIC CARBON
Thomas S. Elleman, Robert B. Price, and Duane N. Sunderman 23 Jul. 1964 19 p refs
(Contract W-7405-ENG-92)
(BMI-1679) OTS: $0.50

To gain a better understanding of possible causes of coating failure of pyrolytic-carbon-cooled fuel particles during irradiation, fission-fragment-induced dimensional changes

were observed by lapping flat surfaces on coated fuel particles and measuring changes in the surface plane following irradiation, by measuring changes of the radius of curvature of unrestrained carbon tubes irradiated on the inner or outer surfaces with fission recoils, and by measuring the deflection of thin carbon disks after one face was irradiated with fission fragments. Fission-fragment-induced contractions were observed, but it was also possible to obtain behavior indicating fission-fragment-induced expansion. Author

N64-26887 Aberdeen Proving Ground, Md. Ballistic Research Labs.
ZONAL HARMONIC PERTURBATIONS OF AN ARTIFICIAL SATELLITE
Boris Garfinkel and Gregory T. Mc Allister May 1964 25 p refs
(BEL-1246; AD-602055)

The paper extends the known solution of the main problem of the artificial satellite theory to include the effects of all the higher zonal harmonics of the geopotential. The method of von Zeipel is ued to calculate the secular and the long-periodic variations of order J_m and J_m/J_2, respectively. The results are exhibited in a compact form, in terms of the associated Legendre polynomials in $(1-e^2)^{-1/2}$ and in cos i. Author

N64-26925 Uppsala U. (Sweden) Quantum Chemistry Group
EVOLUTION OF MOLECULAR SYSTEMS AND THE SEPARATION OF ELECTRONIC AND NUCLEAR MOTIONS Scientific Report No. 8
David Micha 15 Mar. 1964 14 p refs
(Contract AF 61(052)-701)
(ARL-64-134; AD-602208)

A time-dependent approach to the study of molecular systems is used to analyze the interaction between the electronic and nuclear motions. The set of coupled evolution equations for the nuclei, resulting from this treatment, is solved in a first order perturbation approximation to obtain the decoupling of electronic and nuclear motions and to give conditions for its validity. A comparison is made with an adiabatic approximation treatment of the evolution equations and with the Born-Oppenheimer approximation, paying attention to the initial suppositions and to the restrictions in the different cases. Author

24 PHYSICS, PLASMA

Includes fusion; and magnetohydrodynamics. *For related information see*: 05 Astronomy and Astrophysics; 23 Physics, General; and 25 Physics, Solid-State.

N64-25968* Avco-Everett Research Lab., Everett, Mass.
HYPERSONIC MAGNETOHYDRODYNAMICS WITH OR WITHOUT A BLUNT BODY
R. H. Levy, P. J. Gierasch, and D. B. Henderson Washington, NASA, Jul. 1964 75 p refs
(Contract NASw-748)
(NASA-CR-88) OTS: $2.00

The hypersonic flow of a cold gas past a two-dimensional or axially symmetric body containing a two- or three-dimensional magnetic dipole with its axis oriented parallel to the flow was considered. The magnetic moment of the dipole and the size of the body are of arbitrary proportions. A uniform scalar conductivity is turned on by the shock, and the magnetic Reynolds number is low. For low values of the interaction parameter the flow is quasi-aerodynamic. Certain discrepancies existing in the literature on the flow in this regime are reconciled. At high values of the interaction parameter the nature of the flow is quite different. In this regime, it consists of a thin deceleration layer somewhat akin to the aerodynamic shock layer, and an extensive region of low Mach number flow, called the slow flow region, which separates the deceleration layer from the body. The gas in the slow flow region escapes outward at sonic velocity along the field lines. In some circumstances the entire flow field can be supported by the magnet, i.e., without the hot gas touching the body. Assuming a large compression ratio across the shock a relatively simple analysis can be performed. Calculations covering various representative cases are exhibited; the validity and significance of these calculations are discussed. Author

N64-25985 RAND Corp., Santa Monica, Calif.
CONDUCTIVITY OF A HOT ELECTRON GAS
V. Gilinsky and D. F. Du Bois June 1964 37 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4109-PR; AD-600820)

The dissipative part of the high-frequency conductivity tensor of a hot, dilute electron gas near equilibrium is calculated exactly to terms proportional to the plasma parameter k_D^3/n, (the inverse of the number of particles in a Debye sphere), in the limit of classical statistics. The calculation includes high-frequency collective dynamic screening effects consistently to this order. These collective effects have an important effect on the frequency dependence of the conductivity for frequencies greater than about twice the electron plasma frequency. Author

N64-25992 Lincoln Lab., Mass. Inst. of Tech., Lexington
MEASUREMENT OF THE DIAMETER OF THE ELECTRONIC WAKE OF HYPERSONIC PELLETS
M. Labitt 20 Jan. 1964 14 p refs
(Contract AF 19(628)-500)
(TR-342; ESD-TDR-64-20; AD-438816)

From the measurement of the complex dipole moment generated by the presence of an electronic wake in a transverse alternating field, the average volume electron density and the diameter of the cylinder model can be calculated (assuming a uniformly dense cylinder model). Diameters and desities are plotted as a function of time and distance behind the pellet over a pressure range of 5 to 40 torrs, encompassing both the laminar and turbulent regimes. Author

N64-26013 Boeing Scientific Research Labs., Seattle, Wash.
ON THE PLASMA CERENKOV RADIATION
Richard Gerwin and Ralph Guernsey Jul. 1963 131 p refs
(DI-82-0263)

This paper deals with the excitation of Cerenkov radiation of longitudinal electric waves by a charge moving through a collisionless electron plasma with a velocity surpassing the electron thermal speed. The emphasis is placed on detailed discussion of transient effects and the effects of finite projectile size. G.D.B.

N64-26049 RAND Corp., Santa Monica, Calif.
PLASMA CONDUCTIVITY AT LOW FREQUENCIES AND WAVE NUMBERS

M. G. Kivelson and and D. F. Du Bois (Hughes Res. Labs.) Apr. 1964 44 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3755-PR; AD-437797)

The low frequency electromagnetic conductivity of high temperature low density plasmas is examined starting from a linearized kinetic equation of the Balescu type. The equation is solved in the limits $\omega >> \Gamma_{ee}$ and $\Gamma_{ii} >> \omega$, where Γ_{ee} and Γ_{ii} are the inverses of the equipartition times of electrons and ions, respectively. The conductivity is related in a well-known way to the properties of collective waves, and expressions are obtained for the phase velocity and damping of these waves. The results agree with experiment to just within experimental accuracy. Author

N64-26101 ARO, Inc., Arnold Air Force Station, Tenn.
CALCULATION OF THE D-C ELECTRICAL CONDUCTIVITY OF EQUILIBRIUM NITROGEN AND ARGON PLASMA WITH AND WITHOUT ALKALI METAL SEED
R. E. Weber and K. E. Tempelmeyer Arnold Eng. Develop. Center, Jul. 1964 62 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-119; AD-602858)

Scalar electrical conductivities have been computed for nitrogen and argon plasma in thermal equilibrium. Calculations have been made for these gases both unseeded and seeded with cesium, potassium, and NaK in amounts ranging from 0.01% to 10% seed by weight, and cover a range of pressure and temperature from 10^{-2} to 10^{3} atm and from 2,000 to 15,000° K, respectively. Calculated electrical conductivities are presented in figure form as a function of temperature, with seed rate and pressure as parameters. Some effects of applied magnetic fields up to 20,000 gauss on the conductivity of potassium-seeded nitrogen are also given Author

N64-26130 Southampton U. (Gt. Brit.)
ELECTRON-ION RECOMBINATION IN ARGON FLOWING THROUGH A SUPERSONIC NOZZLE
K. N. C. Bray *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 67–87 refs (See N64-26126 18-01)

A mechanism is postulated for the recombination of electrons and ions in a high-temperature argon plasma. This mechanism, together with the quasi-one-dimensional flow equations, is used to study the flow of ionized argon through a supersonic wind-tunnel nozzle. Results of numerical computations are presented that show that, if the postulated mechanism is correct, the actual flow will differ considerably from both equilibrium and frozen flow limits for a wide range of conditions. It is also predicted that the recombination mechanism will lead to an electron temperature considerably in excess of the temperature of the atoms and ions. Author

N64-26137 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
SHOCK TUNNEL STUDIES OF HIGH-ENTHALPY IONIZED AIRFLOWS
A. Q. Eschenroeder, J. W. Daiber, T. C. Golian, and A. Hertzberg *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 217–254 refs (See N64-26126 18-01)
(Contracts AF 49(638)-952; Nonr-2653(00))

Recent developments in shock tunnel techniques permitted experimentation in hypersonic airflows having very high enthalpies. In the present paper, the Cornell Aeronautical Laboratory 6-ft shock tunnel is described, the effects of nonequilibirum flow in such a device are assessed, and high-enthalpy experiments involving nozzle flow ionization are discussed. The 6-ft shock tunnel uses heated high-pressure hydrogen for a driver gas to obtain hypersonic airflows at high stagnation temperatures and pressures. Reflected shock operation is used with the tailored-interface technique to maximize the duration of steady flow. A significant portion of reentry flight conditions can be duplicated for various hypersonic vehicles; however, partial simulation may be used to cover a far wider range of velocity and altitude. For measuring ionization levels and collision frequencies, microwave diagnostics were recently employed. Author

N64-26146 Canadian Armament Research and Development Establishment, Valcartier
PLASMA STUDIES IN HYPERSONIC RANGES
M. Letarte, M. Gravel, and L. E. Moir *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 405–417 refs (See N64-26126 18-11)

Two different approaches are taken for the study of the plasma existing in the high-temperature flow surrounding a hypersonic projectile in flight. The first one, which is internal to the model, makes use of inboard telemetry for studying the properties of the plasma. Up to now, effort has been concentrated on measurement of stagnation temperature, degree of ionization, and infrared radiation in the plasma cap. The second approach, which is external to the model, is based on microwave diagnostic techniques. A Q-band CW doppler radar is used to measure the velocity, drag, and nose-on cross-section of the projectile. A four beam interferometer, also at Q-band, gives the evaluation of the free electron density and of the electron frequency of collison inside the ionized wake. The thermal noise radiated from the wake is measured using an X-band radiometer; in this latter technique, direct information is obtained about the temperature distribution in the hypersonic wake. This paper briefly describes the equipment involved and discusses the results obtained to date. These results are also compared, when possible, with the results predicted by the theory. Author

N64-26147 Royal Armament Research and Development Establishment, Fort Halstead (Gt. Brit.)
LANGMUIR PROBE AND VELOCITY MEASUREMENTS IN THE ARDE PLASMA JET
W. A. Clayden *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 419–446 refs (See N64-26126 18-01)

If a plasma jet is used as a high-temperature source for a hypersonic tunnel the flow through the nozzle will be extremely complicated because of the effects of ionization and dissociation, consequently it is desirable to be able to evaluate the properties of the flow in the working section without resort to assumptions concerning the nature of the flow in the nozzle. Two techniques have recently been developed for the ARDE plasma jet to measure the velocity and the electron density and temperature of the ionized stream. The velocity obtained from the measurements of the potential produced by a magnetic field normal to the direction of flow of ionized gases, and a typical velocity is 10^{5} cm/sec. The effects of the degree of ionization, shape of probes, and the eddy currents on the velocity measurements are discussed. A simple theory is given for the interpretation of results from a Langmuir probe operating in a hypersonic plasma flow when the mean free path of the neutral particles is larger and the Debye length smaller than a typical probe dimension; typical measurements give an electron density of 10^{13} electron/cm^{3} and a temperature of 2,000° K. Author

N64-26150 Royal Armament Research and Development Establishment, Fort Halstead (Gt. Brit.)
THE PROBLEM OF IONIZATIONAL RELAXATION FOR MODERATELY STRONG SHOCKS IN MONATOMIC GASES
D. G. H. Frood *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 485–500 refs (See N64-26126 18-01)

An attempt is made to put into perspective the essential physical problems and conceptual difficulties associated with the development of a satisfactory theory to account for the observed rate of approach to ionizational equilibrium behind shocks in monatomic gases. A mechanism is pointed out for the production of the initial ionization, namely, that mechanism due to the few, free electrons that always exist inherently, to some degree, in the undisturbed region ahead of the shock and which, after crossing the shock front, become capable of initiating the ionizing process. N.E.A.

N64-26154 Canadian Armament Research and Development Establishment, Valcartier
RADIATION MEASUREMENTS FROM THE PLASMA SHEATH SURROUNDING HYPERSONIC PROJECTILES
A. Lemay *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 555–567 refs (See N64-26126 18-01)

Results of measurements of passive radiation from the plasma sheath surrounding a hypersonic projectile are presented appropriate to various reentry flight conditions. The measurements fall into three broad categories corresponding to three main types of experiment performed—those of total intensity of radiation from the stagnation region within given spectral bandwidths, obtained using photodetectors; those of spectral distribution of intensities for the integrated radiation from the plasma as a whole, obtained using conventional spectrographs; and those of spacial distribution of intensities within a given spectral bandwidth, obtained using an image converter camera. The results are of particular interest in the study of relaxation and ablation phenomena, and yield some preliminary information on wake structure. Author

N64-26217 ARO, Inc., Arnold Air Force Station, Tenn.
SPECTROSCOPY OF A SUPERSONIC PLASMA: I. EXCITATION MECHANISM
Le Roy E. Brewer Arnold Eng. Develop. Center, Jul. 1964 17 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-151; AD-602714)

Spectral line emission was strongly influenced by the existence of metastable states in plasmas. The distribution function for excited electronic states in a plasma in which an excess over equilibrium density of metastable atoms is present is derived by the establishment of a suitable model. This is accomplished by considering two different atoms that are identical except for their ground states. A Boltzmann distribution function is written for each type of atom for the upper energy states, and the two distributions are summed to obtain the population of the n^{th} state due to both the normal and metastable atoms. Argon was used as an example for calculations that show that the population of a given excited state may be several orders of magnitude greater than that expected if metastable atoms were not present. When including this new term in the Einstein–Boltzmann spectral line intensity equation, intensities are considerably altered when even a slight excess concentration of metastable atoms is present. Experimental evidence in support of the form of the equation is presented. Author

N64-26236 Paris U., Orsay (France)
KINETIC STUDY OF ELECTRONS IN WEAKLY IONIZED GASES FOR ARGON OR GAS MIXTURES ARGON-HYDROGEN, ARGON-CO
A. Constantin, J. Godart, J. J. Hamm, R. Rioux, and J. L. Delcroix 1964 13 p refs
(Contract AF 61(052)-727)
(AFCRL-64-444; AD-602654)

The drift velocity of electrons due to the electric field in a weakly ionized gas of pure argon is discussed. The supposition that the distribution function of electrons will be essentially determined by the elastic collisions between electrons and molecules is used in this kinetic study. J.L.D.

N64-26247 Brown U., Providence, R.I. Div. of Engineering
EXCITATION OF NONLINEAR CURRENTS AND GENERATION OF HARMONIC WAVES IN AN ISOTROPIC PLASMA
Scientific Report No. 5
Ting-Wei Tang and Lewis Wetzel Jun. 1964 94 p refs
(Contract AF 19(628)-2498)
(AF-249815; AFCRL-64-378; AD-603071)

The nonlinear polarization currents excited by a plane electromagnetic wave in an isotropic plasma are discussed. Nonlinear interactions arising from the magnetic field of the plane wave, the dependence of electron temperature on the field, induced oscillating space charge, and spatial dispersion are examined in some detail, along with their relative importance in different situations. Explicit expressions for the harmonic currents are found by a perturbation analysis. A calculation of the radiation fields established by harmonic currents excited inside an inhomogeneous plasma half-space with linearly increasing electron density is given. The problem is treated for a primary wave in both normal and oblique incidence. In the case of normal incidence without collisions, the second-harmonic current excites a longitudinal second-harmonic field without radiation, while third harmonic currents radiate into the free-space region. The intensity of this radiation is calculated for the extreme cases of large and small density gradients. In the case of oblique incidence, collisions are included but only the quasi-homogeneous limit is considered. A second-harmonic wave is now radiated into free space, its amplitude showing a marked dependence on the angle-of-incidence of the primary wave. Author

N64-26286 California Inst. of Tech., Pasadena Karman Lab.
APPROXIMATE THEORETICAL CALCULATIONS OF CONTINUUM OPACITIES, I. RADIANT ENERGY EMISSION FROM ISOTHERMAL AND NON-ISOTHERMAL GASES, II
S. S. Penner and M. Thomas Nov. 1963 51 p refs
(Contract Nonr-220(45))
(TR-44; AD-427209)

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2. RADIANT ENERGY EMISSION FROM ISOTHERMAL AND NON-ISOTHERMAL GASES M. Thomas and S. S. Penner p 19–32 refs (See N64-26288 18-11)

3. REPRESENTATIVE RESULTS DERIVED FROM THE EDDINGTON-BARBIER APPROXIMATION AND FROM EXACT CALCULATIONS FOR LINE RADIATION M. Thomas and S. S. Penner p 33–50 refs (See N64-26289 18-24)

N64-26287 California Inst. of Tech., Pasadena Karman Lab.
APPROXIMATE THEORETICAL CALCULATION OF CONTINUUM OPACITIES
S. S. Penner and M. Thomas *In its* Approximate Theoret. Calculation of Continuum Opacities, I. Radiant Energy Emission from Isothermal and Non-Isothermal Gases, II Nov. 1963 p 1–18 refs (See N64-26286 18-24)

An approximate procedure is described for the theoretical calculation of the spectral absorption coefficient produced by bound–free and free–free transitions in plasmas containing polyelectronic atoms and ions. The method of calculation is based on the assumption that only two ionized species make important contributions to the opacity and that these two ionic constituents are present in equal concentrations. The approximate formulas yield results that agree with estimates based on detailed computations. Author

N64-26401* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A CRITICAL EVALUATION OF METHODS FOR CALCULATING TRANSPORT COEFFICIENTS OF A PARTIALLY IONIZED GAS
Warren F. Ahtye Repr. from Proc. of the 1964 Heat Transfer and Fluid Mech. Inst., 1964 p 211–225 refs
(NASA-RP-231)

Existing calculations of basic transport coefficients for a partially ionized gas have used questionable various approximations. The purpose of this paper is to determine the degree of accuracy of these approximations. The approach is to calculate the basic transport coefficients by use of the most accurate theory presently available—the second-order Chapman–Enskog formulation. Comparisons are then made between these values and the approximate ones. The approximate values for the viscosity agree with those for the second-order expression within a few percent. The existing approximations result in a zero value for the thermal diffusion coefficient. The more exact theory used in this paper predicts appreciable effects of thermal diffusion. The approximate method for predicting the reactive component of the thermal conductivity is inexact in many areas, the main defect being the neglect of charge separation effects. Author

N64-26406* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SELF-CONSISTENT METHOD FOR DETERMINING THE BOUNDARY SHAPE BETWEEN A PLASMA AND A MAGNETIC FIELD
John C. Baker, David B. Beard, and John C. Young Repr. from Phys. Fluids, v. 7, no. 4, Apr. 1964 p 504–510 refs
(NASA-RP-266)

Description is given of a method of calculation for determining the boundary surface between a plasma and a magnetic field. The method consists of neglecting the curvature of the surface and approximating the magnetic field adjacent to the boundary by a sum of the field due to the local surface current and the plasma-independent magnetic field source. This field is used in the boundary equations to compute the boundary surface. The resulting boundary surface is then used to compute the magnetic field due to the curvature of the surface, and the computation of the boundary surface is repeated. Reiteration of this process is continued until the shapes of two succeeding surfaces differ by no more than the imprecision of the calculation of the magnetic field. The method is demonstrated in a plasma exerting a constant pressure on the boundary, a point dipole immersed in a plasma exerting constant pressure, and a line dipole in a plasma stream exerting a pressure parallel to the stream velocity. IAA

N64-26456 Princeton U., N.J. Plasma Physics Lab.
LANDAU DAMPING AND FINITE-LENGTH EFFECTS IN UNIVERSAL PLASMA INSTABILITIES
Herbert Lashinsky Jun. 1964 13 p refs
(Contract AT(30-1)-1238)
(MATT-275)

Preliminary results of experiments are reported in which the stabilization of the universal instability by the Landau damping of ions was investigated in a plasma whose dimensions satisfy the length-to-radius criterion $L/R \leq 10$. The effect of plasma length on the real part of the oscillation frequency and phenomena that may be called "mode jumping" and "mode locking" was also observed. The last two effects are attributed to nonlinear mode interactions. All results reported pertain to plasma densities $n \leq 7 \times 10^{10}$ cm^{-3}, and it is assumed that collisional effects can be neglected. R.T.K.

N64-26457 Princeton U., N.J. Plasma Physics Lab.
HYDROMAGNETIC STABILIZATION OF TOROIDAL SYSTEMS WITHOUT THE USE OF SHEAR, IN THE PRESENCE OF ROTATIONAL TRANSFORM
Andrew Lenard Jun. 1964 7 p refs
(Contract AT(30-1)-1238)
(MATT-279)

The problem of hydromagnetic stability of a plasma contained in toroidal configurations is discussed. In particular, the question of obtaining this stability in configurations with a rotational transform is discussed, and equations are developed for the externally produced confining field that will give maximum stability. P.V.E.

N64-26465 North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
AXIAL FLOW FROM A RADIALLY CONFINED ELECTRICALLY EXPLODED CYLINDER
J. D. O'Keefe and C. W. Scully 20 Apr. 1964 26 p refs Presented at the AF Third Conf. on Exploding Wires, Boston, 10-12 Mar 1964
(SID-64-874)

The case of axial flow from the end of a metallic cylinder bounded by an insulating wall under capacitor discharge conditions was studied both theoretically and experimentally. Flow parameters for the resulting dense plasma were formulated in terms of experimentally observed energy input rates. Two formulations are given, a quasi-steady approximation and one employing one-dimensional unsteady hydrodynamic equations in Eulerian form. Computations were carried out for various metallic elements, cylinder dimensions, and constraining geometry. Results indicated that, for an input energy of 21,300 joules into a lithium cylinder of 1.5- × 25-mm dimensions, flow velocities were greater than 20 km/sec and densities greater than 0.1 g/cc, for times up to 5 μs. Experimental confirmation of the computed values were obtained by flow velocity measurements obtained from velocity measurements of micron diameter ceramic spheres accelerated by fluid-dynamic drag in the fluxing plasma. Author

N64-26472 National Bureau of Standards, Boulder, Colo. Boulder Labs.
A SURVEY REPORT ON THE PHYSICS OF SYSTEMS OF CHARGED PARTICLES
W. T. Grady, Jr. 6 Mar. 1963 53 p refs
(NBS-7663)

Theoretical descriptions of charged-particles systems are reviewed. The Debye and Huckel treatments of charged-particles

systems are summarized; the classical statistical mechanics of charged-particles systems is discussed; recent work in charged-particles systems is elucidated; and application of the theories is discussed. P.V.E.

N64-26540 Princeton U., N.J. Plasma Physics Lab.
VERIFICATION OF HOT PLASMA THEORY FOR MICROWAVE PROPAGATION AT THE SECOND HARMONIC ELECTRON CYCLOTRON RESONANCE
E. B. Messervey and S. P. Schlesinger (Columbia U.) May 1964 29 p refs
(Contract AT(30-1)-1238)
(MATT-265)

An analysis is presented of an experimentally detected resonance at the second harmonic of the electron cyclotron frequency. Phase shift and attenuation measurements show reasonable agreement with the predictions of hot plasma theory. In this theory, a dispersion relation is derived from a perturbation solution of the linearized collisionless Boltzmann equation with the velocity distribution function of the unperturbed plasma assumed to be Maxwellian. In the experiment 4-mm microwaves were propagated in the extraordinary mode ($E \perp B_0$) across a highly ionized essentially uniform plasma of 10-cm diameter confined in a highly homogeneous (0.05%) magnetic field in the Model C Stellarator. Conditions existing for the measurements are: $5 \lesssim T_e \lesssim 25$ eV; $\omega_p \lesssim \omega/2$; $10^{-5} \lesssim \nu_{coll}/\omega < 5 \times 10^{-4}$; $\Omega = \omega/2$, (Ω is the electron cyclotron frequency). Under these conditions multiple harmonic anomalies as detected by other investigators were not observed. Author

N64-26586 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France)
CONSTANTS OF THE LINEARIZED MOTION OF VLASOV PLASMAS
K. M. Case Jun. 1964 21 p refs
(TH-59)

The constants of motion for a linearized plasma can, at least in simple cases, be characterized very much as in quantum mechanics. Thus a general constant is an arbitrary function (appropriately defined) of the transport operator while the useful constants are powers of that operator. Author

N64-26681 Cornell U., Ithaca, N.Y. Graduate School of Aerospace Engineering
ANALOG STUDIES OF UPSTREAM-INCLINED WAVES IN MAGNETO-GASDYNAMIC FLOW
Lawrence S. Iwan Dec. 1963 39 p refs
(Grant AF-AFOSR-62-201)
(AD-437750)

An analog was devised to study two-dimensional magneto-gasdynamic flow for the case of aligned magnetic and velocity fields and a perfectly conducting compressible fluid. The analog consists of stretched elastic sheets in an incompressible fluid. The elastic sheets are analogous to a magnetic field and produce a body force on the fluid when displaced from their equilibrium positions. The differential equations describing the system are the same as the magnetogasdynamic equations for the case cited, except for the expression for the body force in the momentum equations. Analysis of the analog system reveals striking similarities between the small disturbance propagation characteristics of that system and magnetogasdynamics. An experiment was performed in which a body was towed along a tank filled with water in which sheets of natural rubber were stretched to simulate a uniform magnetic field. Upstream-inclined waves were observed, whose angles with the direction of the body's motion agreed well with the predicted values. Author

N64-26682 Princeton U., N.J. Plasma Physics Lab.
ANNUAL REPORT, JANUARY 1–DECEMBER 31, 1963
17 Apr. 1964 411 p refs
(Contract AT(30-1)-1238)
(MATT-Q-21)

The present status of the stellarator program is summarized briefly along with different investigations being carried out. General areas of research are research with the model C stellarator; experimental research with small devices; theory—kinetic theory and applications to stability, hydromagnetic and C-G-L stability, and wave-plasma phenomena; and special programs in physics and engineering. P.V.E.

N64-26697 Nagoya U. (Japan) Inst. of Plasma Physics
A SOLENOID WITH SINUSOIDAL WINDINGS FOR IOFFE FIELD
Shigeo Nagao Mar. 1964 8 p refs
(IPPJ-26)

The application of an Ioffe field to a stationary plasma device is examined briefly from the technical point of view. A solenoid with sinusoidal windings is used to make an Ioffe field. This device was found to be useful, since it does not necessarily require a low-voltage power source with an extremely high current capacity in order to be effective. R.T.K.

N64-26699 Princeton U., N.J. Plasma Physics Lab.
EQUILIBRIUM OF A PLASMA IN A TOROID WITH FINITE RESISTIVITY, INERTIA AND DENSITY GRADIENT DRIFT
Georg Knorr Jun. 1964 18 p refs
(Contract AT(30-1)-1238)
(MATT-283)

A theoretical study of the equilibrium of a dilute plasma in toroidal geometry with rotational transform was carried out, taking into account finite resistivity and finite inertia. If an additional nonvanishing density gradient drift of the plasma perpendicular to the magnetic field is assumed, the plasma drifts out of the toroid. The characteristic time of this process is a factor of $2r/R$ (R = major radius of the toroid; r = minor radius), smaller than the time found by Pfirsch and Schlüter associated with the diffusion from a toroid. Author

N64-26700 Princeton U., N.J. Plasma Physics Lab.
EFFECTS OF PASSING CURRENT ON PLASMA LOSSES IN A Q-DEVICE
N. D'Angelo and A. Y. Wong Jun. 1964 24 p refs
(Contract AT(30-1)-1238)
(MATT-284)

An interpretation is presented of the falloff of plasma density with passage of current observed in thermally ionized alkali plasmas. The density decreases with increasing current because, as the plasma temperature is raised above its normal value T_0, it becomes increasingly easier for the ions to recombine at the end plates of a Q-device. Experiments are described, that support this view. The statement by von Göler that, for large magnetic fields, the predominant plasma loss in a Q-device consists of recombination at the end plates, appears to be essentially correct. It is unnecessary to postulate enhanced losses across the magnetic lines[1,4] to account for the observed density falloff. Author

N64-26719 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
BIPOLAR FLOW IN A SPECIAL MAGNETIC FIELD
V. N. Danilov 14 Jul. 1964 16 p refs Transl. into ENGLISH from Issled. po Fiz. i Radiotekn., Mosk. Fiz.-Tekhn. Inst., no. 10, 1962 p 67–79
(FTD-TT-64-619/1+2+4; AD-602881)

In a magnetic field the effective compensation of the space charge of an ion flow by electrons can occur. By selecting the appropriate magnetic fields, as high a reciprocal compensation of the electron and ion space charges as desired can be achieved. Author

N64-26735 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
SOME CHARACTERISTICS OF A PLASMA PENETRATING BEYOND THE LIMITS OF THE DISCHARGE SPACE
G. V. Krivoshchekov and I. N. Kalistratova 14 Jul. 1964 6 p ref Transl. into ENGLISH from Izv. Sibirsk. Otd. Akad. Nauk SSSR (Novosibirsk), v. 2, no. 6, 1963 p 121–123
(FTD-TT-64-587/1+2+4; AD-602880)

During a study of a low-voltage arc discharge in mercury vapors, the phenomenon of plasma propagation beyond the limits of the discharge anode was detected, and thus by introducing additional acceleration the conditions of propagation could be varied. This report deals with the use of this phenomenon during the formation of an electron flow in super-high frequency instruments with ion focusing. The introduction of special electrodes, which create an accelerating field, directly after the anode makes it possible to use the properties of the plasma beyond the anode for forming the extended electron flow. Placement of the accelerating electrode relative to the boundary of the plasma, during selected filling of the gas, is determined from the conditions of steadiness of the electron current in the region beyond the electrode. I.v.L.

N64-26740 Nagoya U. (Japan) Inst. of Plasma Physics
ANOMALOUS MICROWAVE RADIATION AT CYCLOTRON RESONANCE IN PARTIALLY IONIZED PLASMAS
Shigetoshi Tanaka, Hiroshi Kubo (Kyoto U.), and Kenji Mitani Mar. 1964 29 p refs
(IPPJ-25)

The anomalous microwave radiation at cyclotron resonance in partially ionized plasmas was investigated. Its radiation is not stationary in time, but is emitted pulsively at some definite phase of the low frequency oscillation, which is present in the d.c. discharge plasma. The peak power of its puled emission is extremely large, and the power obtained is larger by 2×10^4 times than that of the blackbody. Further, such a radiation can be observed at the cathode side plasma, but cannot at the anode side. Meanwhile, a large increment in intensity of this radiation or a corresponding intense absorption is not observed, when an external microwave power is fed to that plasma. The absorption coefficient corresponded to the anomalous radiation seems to be positive, and its amplitude is very small though this radiation is extremely large. Author

N64-26750 Comitato Nazionale per l'Energia Nucleare, Frascati (Italy) Laboratorio Gas Ionizzati
COMPRESSION OF MAGNETIC FIELD BY EXPLODING FOILS
J. G. Linhart and G. Schenk May 1964 19 p refs
(LGI-64/7)

Experiments are described in which a thin cylindrical metalic foil is exploded passing a pulse of electrical current through it. The plasma generated in such an explosion compresses an axial magnetic field. Initial fields of several kilogauss were thus compressed to about 50 kg. Interpretation of the details of the explosion and compression processes is attempted. Author

N64-26837* National Aeronautics and Space Administration, Washington, D.C.
THE DECELERATION AND ENERGY CONVERSIONS OF A PLASMA EXPANDING IN A VACUUM IN THE PRESENCE OF A MAGNETIC FIELD
Yu. P. Rayzer Aug. 1964 20 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 6, 1963 p 19–28
(NASA-TT-F-239) OTS: $0.50

This is an investigation of the energy transformation that takes place during the dispersion of a very rarefied plasma cloud in a vacuum in which a constant and uniform magnetic field is present. General conclusions are stated first that follow from the application of a purely phenomenological theory to the problem of the expansion and deceleration of a superconducting sphere. During deceleration the plasma loses a significant part of its energy. This energy, along with some magnetic energy concentrated earlier in the central portion, is removed to great distances by the electromagnetic field and even to infinity if the magnetic field extends that far. The energy flow (Poynting vector) in electromagnetic momentum is defined by the product of the induced electric field and the constant external magnetic field. Author

N64-26876 Elcon Lab., Peabody, Mass.
INTERACTION OF ELECTROMAGNETIC WAVES AND CLASSICAL PLASMAS Monthly Report No. 11
Robert Siegal 15 May 1964 8 p
(Contract AF 33(657)-11671)
(R-5-64-1; AD-603523)

Mathematical expressions for plasma conductivities, when the plasma is perturbed by one signal and probed by another, were analyzed. Consequently, a physical picture has been evolved that relates directly to the analytical and experimental program; a theory has been generalized for the presence of three signals; and a partial solution has been derived. D.E.W.

N64-26878 California U., Livermore Lawrence Radiation Lab.
ALFV'EN WAVES IN NONUNIFORM PLASMA
C. W. Hartman 19 May 1964 20 p refs Presented at the Am. Phys. Soc. Meeting, Wash., D.C., 27–30 Apr. 1964
(Contract W-7405-ENG-48)
(UCRL-7721) OTS: $0.50

The properties of small-amplitude, torsional, hydromagnetic waves in an infinite-conductivity, plane, current sheet are described by singular modes. Logarithmic singularity occurs at the resonance point in the layer where $\omega = k \cdot v_a$. Finite solutions are obtained for wave packets when a spread in frequency or wave number is present, or when the infinite-conductivity hydromagnetic assumption is relaxed. Experimental observations of local torsional waves in a hard-core pinch show azimuthal spreading and axial attenuation qualitatively consistent with the presence of magnetic shear. Author

N64-26885 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON THE QUESTION OF EXCITING LONGITUDINAL WAVES IN PLASMA BY RADIO WAVES
A. M. Fedorchenko 8 Jul. 1964 8 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), p 555–559
(FTD-TT-64-174/1+2; AD-600136)

The problem of transforming transverse electromagnetic waves into longitudinal waves, which is of great importance to radio engineering, is discussed. The stream of energy connected with longitudinal waves was calculated to gain a quantitative

idea of the intensity of such waves. A stream of energy, connected with waves excited in a plasma by an electromagnetic wave falling on the separation boundary of two media, was investigated; it was found that this stream of energy was perpendicular through the area to the separation boundary. Since the transverse electromagnetic wave in a plasma becomes the surface wave (i.e., it extinguishes in the depth of the plasma), it was possible to show the form of the separation boundary along the remaining distance. It is indicated that only an entirely insignificant part of the energy of transverse waves is transformed into longitudinal-wave energy. I.v.L.

N64-26907* Maryland U., College Park Center for Atmospheric and Space Physics
A RELATIONSHIP FOR PLASMA SHEATHS ABOUT LANGMUIR PROBES Scientific Report No. 1
Richard T. Bettinger and E. Harris Walker Jan. 1964 15 p refs
(Grant NsG-58-60; Contract AF 19(628)-2792)
(AFCRL-64-429; AD-603008)

The case of a spherical body in both monoenergetic and Maxwellian plasmas is presented. The conservation of energy and angular momentum relations are used to obtain an equation for the ion and electron densities in terms of the local electric field. These equations, used in conjunction with the Poisson equation, are solved numerically. In addition to the electric field and the particle density distributions, the voltage-current probe characteristic curves are obtained. The calculations are, however, lengthy so that results must be displayed graphically or expressed by an approximate analytic expression J.L.D.

N64-26917 Electro-Optical Systems, Inc., Pasadena, Calif. Fluid Physics Div.
STUDY OF ELECTRODE ATTACHMENT REGIONS IN HIGH CURRENT GASEOUS DISCHARGES Final Report, 18 Jun. 1962–18 Sep. 1963
Gordon L. Cann and Robert L. Harder Arnold AF Sta., Tenn., Arnold Eng. Develop. Center, Aug. 1964 68 p refs
(Contract AF 40(600)-987)
(EOS-3240-Final; AEDC-TDR-64-107; AD-603342)

This report discusses an experimental and theoretical study of electrode attachment regions in a high-current gaseous discharge, particularly in the mechanisms causing retrograde motion of the arc attachment spot on the cathode. Work included mathematical analysis and formulation of a theory of cathode emission under these operating conditions and experimental investigations to correlate the theory with observed effects. Experiments and apparatus for measuring power loss to arc cathodes were set up. Analysis of the retrograde motion of the cathode spot was made, and experiments to confirm the analysis were performed. The study resulted in the definition of a mathematical problem. The MHD equations must be solved in the electrode and in the gas, and the two solutions matched at the interface. Author

N64-26920 Microwave Associates, Inc., Burlington, Mass.
MILLIMETER WAVE COMPONENT DEVELOPMENT (BEAM-PLASMA AMPLIFIER)
Paul Chorney and Richard J. Madore Griffiss AFB, N.Y., RADC, Jul. 1964 30 p refs
(Contract AF 30(602)-2948)
(RADC-TDR-64-207; AD-603264)

Plasma experiments are described on additional plasma testers. High density measurements taken compare quite closely with data obtained from the previous tester R-3. The data show that a plasma frequency of 140 Gc can be obtained at approximately 3.0 amps in xenon gas at a pressure of 40×10^{-3} torr. The design of a BPA study vehicle for experiments at 2 mm is described. The basis for the design and the salient points of the mechanical construction are also pointed out. The construction of E-plane and H-plane bends are described, as well as that of a sliding short. The output of the 4-2 mm doubler was improved by 2.7 db with the use of the rejection filter. Author

N64-26956 Radio Corp. of America, Princeton, N.J. RCA Labs.
INVESTIGATION AND STUDY OF ELECTRON BEAM PLASMA SUBMILLIMETER GENERATION Final Report, 1 Apr. 1963–31 Mar. 1964
G. A. Swartz and L. S. Napoli Wright-Patterson AFB, Ohio, AF Avionics Lab., Jul. 1964 70 p refs
(Contract AF 33(657)-11069)
(AL-TDR-64-155; AD-603247)

A stable cesium plasma with a density of 10^{15} ions/cm^3 (plasma frequency—300 Gc) and 50% ionization was produced by a modified Penning arc. The hot anode was a significant factor in the achievement of this very dense highly ionized plasma. Plasma instabilities, normally present in the Penning arc, rotated in the $j \times B$ direction. These instabilities were damped by collisions between the rotating ions and the stationary neutral atoms. Radial and axial plasma density variations were measured. The radial density gradient decreased when the plasma became stable. Strong coupling was measured between the TEM mode in a coaxial line and the backward wave in a tubular plasma. Analysis indicates that a tubular plasma with a large outer diameter cannot be used in a waveguide-plasma coupler because of mode coupling with the TM_{01} waveguide mode. A 300-Gc beam-plasma amplifier was designed that used tubular plasmas as couplers and the Penning arc for plasma generation. Author

25 PHYSICS, SOLID-STATE

Includes semiconductor theory; and masers. *For related information see*: 09 Electronics; 23 Physics, General; and 24 Physics, Plasma.

N64-25871* Illinois U., Urbana
AN EXPERIMENTAL INVESTIGATION OF RADIATION EFFECTS IN SEMICONDUCTORS
W. Dale Compton Washington, NASA, Jul. 1964 11 p refs
(Grant NsG-228-62)
(NASA-TN-D-2364) OTS: $0.50

The present experiments are concerned with the radiation-induced changes in the minority carrier lifetime of silicon, of the influence of radiation upon the recombination luminescence of germanium and silicon, and the influence of radiation upon the impurity conduction of germanium. A brief description of the techniques involved and the present status of these studies are given. Author

N64-25965 Grumman Aircraft Engineering Corp., Bethpage, N.Y. Research Dept.
REQUIREMENT FOR BREWSTER ANGLE WINDOW FOR LOW GAIN LASING SYSTEM
K. G. Leib Feb. 1964 8 p ref
(RN-177)

In many gas laser systems, the requirements on the Brewster angle output windows are quite modest because of the high gain of the system. When the gain is a fraction of a percent, these requirements become more stringent. This report summarizes the calculation for small deviations from the Brewster angle for a number of materials. G.D.B.

N64-25976 Kansas State U., Manhattan
THE PREPARATION AND PROPERTIES OF THIN FILMS OF SEMICONDUCTORS Final Report
E. Brock Dale, Gerard Senecal, David H. Huebner, Fred K. Wong, and Allen Beale 1 Mar. 1964 114 p refs
(Contract AF 19(604)-7218)
(AFCRL-64-278; AD-600725)

Included in the activities reported are the following: (1) InSb films 550 and 3,750 A thick were deposited on glass substrates by vacuum evaporation from a graphite crucible held at about 1,400° C. Average stoichiometry was preserved by evaporating small pieces of InSb in toto. The vacuum system was pumped down to about 10^{-6} torr before evaporation, and the pressure rose to about 10^{-5} torr during the evaporation. The Hall coefficient and the conductivity were monitored during annealing. Annealing appeared to affect both a recombination of free In and Sb and a recrystallization of very small crystallites into larger ones. (2) InSb was evaporated in vacuum onto heated substrates of CaF_2 and several of the alkali halides. The proper stoichiometric proportions were preserved by evaporating small pieces of InSb in toto. Evaporation rate and substrate temperature were varied in an effort to obtain single-crystal films. Little or no evidence of crystallinity was noted in films deposited on KBr, LiF, or NaCl. Partly orientated films were obtained on CaF_2 substrates at temperatures above 100° C. (3) The composition of the vapor above evaporating charges of an In-Sb mixture was determined. I.v.L.

N64-25994 Microwave Associates, Inc., Burlington, Mass.
SOLID-STATE RF GENERATOR
F. P. Collins [1964] 9 p
(Contract NObsr-89356)
(QPR-3; AD-600701)

Two major areas were investigated during this period: (1) the possibility of using the RCA TA 2307 silicon transistor as a high-power 500-mc amplifier; and (2) the development of a 500-mc voltage-tuned oscillator. R.T.K.

N64-26081* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MOMENTUM TRANSFER AND CRATERING EFFECTS PRODUCED BY GIANT LASER PULSES
Frank Neuman Repr. from Appl. Phys. Letters, v. 4, no. 9, 1 May 1964 3 p refs
(NASA-RP-267)

The momentum transfer and cratering effects caused by impacts of focused laser light on the surfaces of several metals are presented. Laser pulse energy measurements were obtained by three independent instruments: (1) a commercial integrating photodiode calorimeter; (2) a blackbody calorimeter; and (3) the momentum transducer. The results indicate that the momenta produced by normal laser pulses strongly depend on the thermal properties of the target material. For the materials tested, the momentum ratio is closely proportional to the product of the relative melting point and to the thermal conductivity. J.L.D.

N64-26117 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PRODUCTION AND DIELECTRIC PROPERTIES OF SINGLE CRYSTALS OF SOLID SOLUTIONS OF $Pb(TiO_3$–$ZrO_3)$, LEAD METANIOBATE, AND CRYSTALS OF SOLID SOLUTIONS OF LEAD METANIOBATE AND LEAD TITANATE
A. L. Khodakov and M. L' Sholokhovich 28 May 1961 12 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedeniy, Fiz. (Tomsk), no. 2, 1961 p 85–91
(FTD-TT-64-320/1+2+4; AD-602315)

This work describes the production and dielectric properties of solid solution single crystals of lead metatitanate and lead metazirconate and of single crystals of lead metaniobate and its solid solutions with lead titanate. It was established that the conductivity of $Pb(Ti\text{-}Zr)O_3$ crystals strongly increases as temperature rises. Small additions of $PbZrO_3$ did not substantially affect the dielectric properties of solid solutions. Studying the dielectric properties of $PbNb_2O_6$ crystals enabled us to establish the conditions for converting them from a nonferroelectric to a ferroelectric modification. Author

N64-26223 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
THE CONVOLUTION MOLECULE METHOD AND ITS APPLICATION TO CRYSTAL STRUCTURE ANALYSIS
Georg Will Mar. 1964 76 p refs
(USAELRDL-TR-2436; AD-602926)

Convolution molecules are molecular Patterson diagrams. Inserted in the unit cell properly, as described by the convolution molecule structure, they allow deconvolution of a Patterson diagram, leading to orientational and translational parameters of the molecules. The convolution molecule structures are derived by a new method and are tabulated for all space groups of triclinic, monoclinic, and orthorhombic symmetry. Author

N64-26225 Philco Corp., Blue Bell, Pa. Scientific Lab.
A FUNDAMENTAL STUDY OF EPITAXY BY FLASH EVAPORATION Second Semi-Annual Scientific Report
John L. Richards 30 Mar. 1964 36 p refs
(Contract AF 19(628)-2937)
(A049-AFCRL; AFCRL-64-407; AD-602442)

A study has been made of the impurity doping of flash evaporated epitaxial films of III-V semiconductors. Homojunctions and heterojunctions were prepared, and their electrical characteristics were determined. The germanium-germanium epitaxial system was studied so that certain parameters involved in "in situ" doping by flash evaporation could be determined more readily. An investigation has been made of the direct and indirect epitaxy of compound semiconductors on mica substrates. Author

N64-26230 Naval Ordnance Lab., White Oak, Md. Applied Physics Dept.
SOLID STATE RESEARCH FOR THE YEAR 1963
W. W. Scanlon, ed. 17 Feb. 1964 73 p refs
(NOLTR-64-30; AD-442905)

A single crystal of dysprosium was found to have the largest magnetostrictive effect ever reported. Neutron diffraction studies reveal the presence of anisotropic unpaired spin densities in canted antiferromagnetic systems. In PbS the effective mass was shown to depend significantly upon carrier concentration and temperature, and the band structure was shown to have four valleys in the conduction band. Two conduction bands have been found in SnTe. Improved epitaxial films have permitted optical studies of the lead salt semiconductors from the quartz ultraviolet region to 4 mm in the microwave region. A new scattering

mechanism, independent of temperature, has been discovered in these films. A significant technical advance has been made permitting rolling sheets of Sendust as thin as 0.011 in. At about room temperature a Martensitic transformation was shown to occur in near stoichiometric TiNi, clarifying some confusion on the phase diagram for this material. Author

N64-26232 Rome Air Development Center, Griffiss AFB, N.Y. Research and Technology Div.
SOLID STATE LIGHT VALVE STUDY
Edward J. Calucci, Bruce C. Ganzler, and Allen C. Clough Jun. 1964 33 p refs
(RADC-TDR-64-192; AD-602666)

The feasibility of using an electro-optic crystal as a modulating element in a light valve projection display system is demonstrated. A description of the electro-optic effect in solid-state crystals and measurements of their electrical and optical properties are presented. A typical display concept is considered for possible application to command and control systems. A description of an experimental model, illustrated images, and a discussion of the various display parameters are also included. Author

N64-26238 Naval Ordnance Lab., White Oak, Md.
ELECTRICAL RESISTIVITY OF NAPHTHALENE, PHENANTHRENE AND GLUCOSE
R. W. Warfield Jul. 1964 11 p refs
(NOLTR-63-75)

The electrical volume resistivity of naphthalene, phenanthrene, and glucose has been determined in the region of the melting point and, in the case of glucose, in the glass transition region. Both naphthalene and phenanthrene exhibit abrupt increases in the magnitude of the resistivity upon solidification and crystallization from the melt. This change in magnitude and the subsequent increase in the temperature dependence of the resistivity are attributed to the sudden formation of a polycrystalline solid. Glucose, on the other hand, which is an amorphous solid, exhibits no such abrupt increases. However, differences in the temperature dependence of the resistivity of glucose are found in the glass transition region. These differences are discussed. The results of this investigation show that electrical volume resistivity techniques are suitable for investigating the kinetics of crystallization.
Author

N64-26248* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
MAGNETIC FIELD FROM A FINITE THIN CONE BY USE OF LEGENDRE POLYNOMIALS
Lawrence Flax and Edmund E. Callaghan Washington, NASA, Aug. 1964 43 p refs
(NASA-TN-D-2400) OTS: $1.25

The use of zonal harmonics to evaluate magnetic fields generated by axisymmetric current sheets for all regions either near or far from the current elements is demonstrated for the particular case of a right-circular cone. Solutions of the equations for points within and outside the current sheet are presented in tables and figures. Author

N64-26264 Lincoln Lab., Mass. Inst. of Tech., Lexington
SOLID STATE Division 8 Quarterly Progress Report, 1 Jan.–31 Mar. 1964
Alan L. Mc Whorter and Peter E. Tannenwald 5 May 1964 17 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-47; AD-439365)

The current status in the following areas is discussed: (1) solid-state device research, with emphasis on diode lasers; (2) laser research, with emphasis on Raman emission; (3) materials research, with emphasis on growing refractory crystals; (4) band structure and spectroscopy of solids (Bi, Sb, and HgSe); and (5) magnetism and resonance, with emphasis on Heisenberg exchange in the molecular-field approximation. I.v.L.

N64-26273 Harshaw Chemical Co., Cleveland, Ohio Crystal-Solid State Div.
STUDY OF PHOTOCONDUCTIVITY IN THIN FILMS Interim Engineering Report, 1 Nov.–1 May, 1963
E. L. Lind, E. R. Hill, and D. H. Dickey 15 May 1964 41 p
(Contract AF 33(615)-1090)
(AD-440163)

The influence of a number of preparation variables on the electrical properties of CdSe coevaporated films has been investigated. These variables were the nature of the substrate, the temperature of the substrate, coevaporation with Ga, and cooling of the film from preparation temperature under Cd and Se pressure. These variables allow some control over the concentration of one type of donor center and the mobility of current carriers. The photoelectronic properties of CdSe films have been modified by a number of fast treatments. These were constituent annealing, oxidation, and microrecrystallization. Constituent annealing and oxidation sharply reduce the resistivity of CdSe films. However, microrecrystallization provides a means of raising the resistivity and inducing photosensitivity in CdSe films. Author

N64-26292 Little (Arthur D.) Inc., Cambridge, Mass.
SUPERCONDUCTIVE EFFECTS IN THIN FILMS Final Report, Jan. 1962–Mar. 1964
S. Shapiro and E. J. Mc Niff, Jr. Wright-Patterson AFB, Ohio. AF Avionics Lab., Mar. 1964 83 p refs
(Contract AF 33(657)-7915)
(AL-TDR-64-46; AD-439221)

A feasibility study was conducted on the use of the superconductive properties of certain thin-film configurations to perform electronic functions, with emphasis being given to the phenomenon of electron tunneling between superconductors, as exhibited in suitably prepared thin films. Investigations were carried out involving the use of tunneling samples as detectors and as mixers at RF and microwave frequencies. Radiofrequency, X-band, and K-band detection experiments were carried out at 2 mc, and the I-V characteristic in each case was successfully analyzed by a simple model based upon an equivalent circuit representation of the tunnel structure. The mixing of two microwave signals, differing by 30 mc, was observed at various microwave power levels. Experimental verification of the pair-tunneling processes predicted by Johnson was carried out at X and K bands, and the predicted Bessel function variation of the observed current-step regions was confirmed by the experimental results. The use by other workers of a tunneling sample as an RF oscillator and amplifier is discussed, and comments are made on the suitability of tunneling samples for practical applications. I.v.L.

N64-26302 Technical Research Group, Inc., Melville, N.Y.
RESEARCH ON PROPERTIES OF LASER DEVICES Eighth Quarterly Technical Summary Report, 1 Mar.–31 May 1964
R. Kaplan, ed. [1964] 75 p refs
(Contract AF 49(638)-673; ARPA Order 256-62; Proj. Defender)
(TRG-134-QTR-8; AD-443700)

The rate equations have been solved to yield the level populations in collision-relaxed laser media; machine computations involving as many as 43 levels in Mn and La predict inversions in steady-state discharges. An Al_2O_3 tube for vaporizing Mn has been rebuilt using Al_2O_3 sand as insulation. The experimental implementation of a photodissociation laser has continued; the effect of heat induced turbulence and convection within the optical resonator has been largely eliminated. The development of a nuclear-pumped solid-state laser has continued. A 90% increase in the single-mode power and efficiency of a gas laser has been achieved by diffraction coupling of the output around a small spot reflector; mode selection was achieved without increasing alignment tolerances; and a computation of diffraction effects in cavities having low Fresnel numbers was carried out. Author

N64-26353* Hydronautics, Inc., Laurel, Md.
CAVITATION DAMAGE IN LIQUID METALS Quarterly Progress Report, 2 Apr.–2 Jul. 1963
H. S. Preiser and A. Thiruven Adam 1 Sep. 1963 16 p refs
(Contract NASr -105)
(NASA-CR-56724; QPR-235-5) OTS: $1.60 ph

Maximum research effort was applied to the design of a new research test facility for cavitation-damage testing of refractory materials in liquid sodium at high temperature. A feasibility study was completed that demonstrated the possibility of incorporating a sodium loop into a vacuum dry box. A systematic series of experiments were performed to determine how small variations of geometric parameters associated with the magnetostriction apparatus would affect cavitation-damage rate. The results indicate that beaker size, liquid depth, and depth of immersion have no effect on cavitation-damage rate within the limits tested. R.T.K.

N64-26365* Rice U., Houston, Tex.
RESEARCH ON THE PHYSICS OF SOLID MATERIALS Semiannual Status Report No. 10, Nov. 1, 1963–Apr. 30, 1964
Franz R. Brotzen [1964] 20 p refs

The current status of research in the following areas is discussed: (1) solid-state physics; (2) physical metallurgy; and (3) the chemistry of solids. Also, nine papers were published, four papers were accepted for publication, and five papers were submitted to journals for publication. All of these papers resulted from work carried out under the grant and are listed in the appendix. I.v.L.

N64-26467 Iowa State U. of Science and Tech., Ames Ames Lab.
THEORY OF ZEEMAN EFFECT FOR RARE-EARTH IONS IN CRYSTAL FIELD WITH C_{3h} SYMMETRY
T. Murao, F. H. Spedding, and R. H. Good, Jr. Apr. 1964 130 p refs
(Contract W-7405-ENG-82)
(IS-871)

The theory of the crystal-field quantum number for the C_{3h} group is developed in terms of an operator method. The effect of an applied magnetic field on rare-earth ions in the C_{3h} crystal field is treated by perturbation theory. The Zeeman effect of each crystal-field eigenstate is investigated, and the results are summarized in tabular form. The general theory developed is applied to Tm^{3+} and Er^{3+} ions, and transitions from the ground states to all possible excited states were investigated in detail. R.T.K.

N64-26489 Massachusetts Inst. of Tech., Cambridge
SEMICONDUCTOR CATALYSIS: SIMULTANEOUS MEASUREMENT OF KINETICS AND SURFACE ELECTRICAL PROPERTIES
Robert P. Merrill and Raymond F. Baddour (Ph.D. Thesis) 15 May 1964 160 p refs
(Sponsored by ONR)
(TR-1; AD-600080)

The relationship between the surface electrical properties of a semiconductor catalyst and its catalytic activity was investigated theoretically and experimentally. A method was developed for introducing the specific properties of the surface bond between the adsorbed species and the catalytic surface into the physical description of the semiconductor surface. A program is proposed for the measurement simultaneously of surface conductivity and recombination velocity on germanium and of reaction kinetics of the decomposition of ethanol. In the kinetic experiments, it was found that the catalysts produced by vacuum cleavage are much more active than catalysts produced by crushing in air and subsequent reduction in hydrogen, although the activation energies were similar. Treating the vacuum-crushed catalyst with hydrogen lowered both the activation energy and the rate. P.V.E.

N64-26518 Harvard U., Cambridge, Mass. Cruft Lab.
MODULATION OF THE LINEAR-OPTIC EFFECT AT MICROWAVE FREQUENCIES Technical Report No. 433
Robert A. Myers Nov. 1963 199 p refs
(Contract Nonr-1866(16))
(NR-372-012; AD-600461)

A general study of the problem of modulation of light at microwave frequencies has been carried out, with emphasis on modulation of the linear electro-optic effect. A simple microwave-optical mixer was designed, consisting of a near-resonant section of a dielectric waveguide in a brass holder. The behavior of this device as a mixer and its separate microwave and optical properties, particularly the properties of the nonlinear dielectrics potassium dihydrogen phosphate (KDP) and ammonium dihydrogen phosphate (ADP) were studied. The expected dependence of the modulated signal on microwave power and optical polarization was verified, and the first observation of the dispersion of the electro-optic effect at microwave frequenceis was made. D.S.G.

N64-26573* National Aeronautics and Space Administration. Goddard Space Flight Center Greenbelt, Md.
AMBIPOLAR DIFFUSION IN SEMICONDUCTORS
F. E. Geiger, Jr. and F. G. Cunningham Repr. from Am. J. Phys., v. 32, no. 5, May 1964 p 336–342 refs
(NASA-RD-243)

The derivation is given of an expression for the ambipolar diffusion contribution to the electron thermal conductivity, based on ter Haar's work. A general expression is obtained for heat conductivity using concepts of the kinetic theory of gases and the assumption of an electron mean free path. The concepts of band theory and semiconductor statistics are introduced into the kinetic theory equations, and, using Boltzmann statistics, the final expression for the ambipolar contribution agrees, except for numerical constants, with the exact form derived from considerations based on the Boltzmann transport equation. The application of Fermi–Dirac statistics to the problem yields no ambipolar diffusion term as a correction to the conductivity, if terms higher than the first order of the reciprocal of the reduced Fermi level are neglected. This is in agreement with the exact results based on the Boltzmann transport equation where the ambipolar term contains only second and higher order terms of the reciprocal of the reduced Fermi level. IAA

N64-26595* Cornell U., Ithaca, N.Y. Lab. of Atomic and Solid State Physics
[EXPERIMENTAL STUDY OF OPTICAL AND ELECTRONIC PROPERTIES OF ALKALI HALIDES UNDER VACUUM ULTRAVIOLET RADIATION] Final Report
P. L. Hartman Jun. 1964 15 p refs
(Grant NsG-212-61)
(NASA-CR-58134) OTS: $1.60 ph

Localized optical excitation in alkali halides was studied, with special emphasis on the correlation of absorption and radiative decay (luminescence). The α-center luminescence and the luminescence due to excited iodine ions, diluted in a KCl host lattice, were investigated, and the extension of the useful range of the vacuum monochromators to as high a photon energy as possible was studied. A new light source and a new detection system were constructed in an attempt to reach higher photon energies for use in the optical studies. R.T.K.

N64-26620 Delaware U., Newark
LAYER-LIKE FIELD INHOMOGENEITIES IN PHOTOCONDUCTORS IN THE PRE-BREAKDOWN RANGE
K. W. Boer [1964] 12 p refs
(Grant Nonr(G)-00046-63)
(AD-600830)

Characteristic layer-like field inhomogeneities in homogeneous photoconductors that move from cathode to anode must occur when the carrier density n decreases with increasing field F as $n \sim F^{-\alpha}$ if $\alpha > 1 - \beta$, with carrier mobility $\mu \sim F^{-\beta}$. The decrease in n can be caused by field quenching. The critical voltage for initiation of these inhomogeneities decreases with optical excitation and increases with optical quenching in agreement with theory and experiment. Author

N64-26621 Aberdeen Proving Ground, Md. Terminal Ballistics Lab.
THE USE OF THE He^3 SPECTROMETER IN NEUTRON ATTENUATION MEASUREMENTS
A. Manning, T. Jeter, H. Schuckler, and W. Slack Feb. 1964 12 p refs
(BRL-MEMO-1545; AD-600057)

The He^3 sandwich-type spectrometer proved to be an extremely good detector for making neutron spectra and attenuation measurements. A method of procedure is outlined to demonstrate how neutron relaxation lengths can be measured easily and how this technique can be applied to other neutron measurement problems. Author

N64-26622 Bausch and Lomb, Inc., Rochester, N.Y. Research and Development Div.
INFRARED COATING STUDIES Final Report, 15 Dec. 1963–15 Mar. 1964
A. F. Turner and J. Masso [1964] 23 p ref
(Contract DA-44-009-AMC-124(T))
(AD-600264)

The following are discussed : (1) experimental refractive indices of $PbCl_2$ and ZnTe films; (2) experimental reststrahlen enhancement of LiF films; (3) experimental reststrahlen enhancement of crystalline LiF; and (4) experimental vacuum coating problems with substrate and filming materials. R.T.K.

N64-26626 Air Force Systems Command, Wright-Patterson AFB, Ohio Avionics Lab.
IMPROVED LONG WAVELENGTH RESPONSE OF PHOTOEMMISSIVE SURFACES Technical Documentary Report
Bilyie E. Rambo Apr. 1964 20 p refs
(AL-TDR-64-19; AD-600168)

The usefulness of photoemitters as detectors for optical lasers is limited by their very poor quantum efficiency in the red and infrared portion of the spectrum. For example, the quantum sensitivity of the S-20 photosurface at 0.7μ is approximately 0.25%. However, some 70% of the incident radiation at 0.7μ is transmitted through the semitransparent S-20 surface and is lost. In the present experiment, the incident light from a monochromator was trapped by total internal reflection in the faceplate, resulting in multiple encounters of the light with the photocathode and, consequently, in a high degree of absorption by the cathode. Gains of three and five times the normal sensitivity of the S-20 photosurface at 0.7μ were observed using this technique, depending on the polarization of the incident light. Curves showing the spectral dependence of this gain for both axes of polarization are presented. The internal reflection technique may be applied to any tube having a flat faceplate backed by a semitransparent photocathode. However, any imaging capability of the tube is lost. Author

N64-26641 Massachusetts Inst. of Tech., Cambridge
CRYSTAL STRUCTURE, SYNTHESIS, AND MAGNETIC PROPERTIES OF CHRYSOBERYL
Robert E. Newnham et al Nov. 1963 26 p refs
(Contract AF 33(616)-8353)
(TR-183; AD-437753)

Chrysoberyl—Al_2BeO_4—is a hexagonal close-packed analog to the cubic close-packed spinel structure, with aluminum in octahedral coordination and beryllium in tetrahedral sites. An X-ray diffraction least-squares refinement of its structure is reported. Experimental evidence for selective substitution in $(Al,Fe)_2BeO_4$ and $(Al,Cr)_2BeO_4$ ceramics is presented. A description is given of flux growth of chrysoberyl and alexandrite and of the magnetic properties of chromium chrysoberyl. R.T.K.

N64-26649 Lincoln Lab., Mass. Inst. of Tech., Lexington
SOLID STATE RESEARCH, 1963, NO. 2
16 Aug. 1963 64 p refs
(Contract AF 19(628)-500)
(AD-439686)

An attempt is made to summarize what is known and what can be deduced about Mercury's orbital and physical elements, its temperature, surface characteristics, atmosphere, radiation belts and magnetic field, and biological importance. A brief discussion of Mercury's importance in the study of the origin and evolution of the solar system is included. P.V.E.

N64-26652 American Optical Co., Southbridge, Mass. Research Center
EXPERIMENTAL VERIFICATION OF SUN POWERED LASER TRANSMITTER Interim Engineering Report No. 2, Aug.–Nov. 1962
D. A. La Marre, G. R. Simpson, and M. R. Thorburn [1962] 41 p refs
(Contract AF 33(657)-8619)
(IER-2; AD-437864)

The continuing effort of experimentation and design leading to the delivery of an experimental model of a sun-powered laser transmitter is described. The design and fabrication of the transmitter is discussed with respect to the optical system and mount. An experimental Nd-doped $CaWO_4$ laser is described. Related to this description are integral pump optics requirements, fabrication problems, and thermal considerations of the unit. Experimental Nd-doped glass lasers are discussed in both the short- and long-fiber configurations. Author

N64-26655 Bendix Corp., Ann Arbor, Mich. Systems Div.
RADIATION EFFECTS PARAMETERS IN NAP APPLICATIONS Fifth Monthly Progress Letter, Dec. 1963
16 Jan. 1964 18 p refs
(Contract AF 29(601)-5911)
(BSR-847; AD-437878)

This report is concerned with comparing radiation damage in semiconductors resulting from various nuclear reactor environments. The overall test plan consists of three tests. The first is to test selected devices in the gamma-radiation environment from a Co^{60} source. The second test will expose some of the devices from the first test plus some new (previously unirradiated) devices in a hard neutron spectrum obtained using water shielding in a reactor pool. The third test will include some of the devices from the first two tests and some new devices. These will be irradiated in a typical test reactor spectrum near the face of the reactor core. I.v.L.

N64-26674 American Optical Co., Southbridge, Mass. Research Center
EXPERIMENTAL VERIFICATION OF SUN-POWERED LASER TRANSMITTER Interim Engineering Report No. 1
D. A. LaMarre [1962] 43 p refs
(Contract AF 33(657)-8619)
(AD-437865)

The feasibility of using four-level laser materials is investigated. A general expression is derived for the figure of merit "G" of a four-level laser in the sun-powered end-pumped configuration. ("G" relates the laser parameters to the power input needed for threshold lasering). In a survey of possible new laser materials, two four-level types, neodymium-doped calcium tungstate and neodymium-doped glass, were determined to be promising. Thermal problems involved in cooling neodyminum-doped glass are analyzed. The status of the design and construction of the sun-tracking laser mount is specified. Author

N64-26678 Stanford Research Inst., Menlo Park, Calif.
THERMOELECTRIC MATERIALS Quarterly Progress Report, 8 Oct. 1963–8 Jan. 1964
J. W. Johnson [1964] 10 p
(Contract NObs-88487)
(Rept.-3; AD-439683)

Measurements of the Seebeck coefficient and resistivity of the cuprous sulfide-lead sulfide system in the liquid state were made for compositions containing 75, 50, and 25 mole percent cuprous sulfide. The 75 mole percent cuprous sulfide composition is a p-type semiconductor having a Seebeck coefficient of $+325\ \mu V/\phi C$ at 800° C and a resistivity of 2.1×10^{-2} ohm cm at the same temperature. The 50 and 25 mole percent cuprous sulfide compositions are both n-type; the 25 mole percent composition has a Seebeck coefficient of $-185\ \mu V/C$ and a resistivity of 2.6×10^{-2} ohm cm at 800° C. The 50 mole percent composition has a resistivity that is higher by a factor of 2 over the 25 and 75 compositions, and a Seebeck coefficient that is intermediate between them. Data on the Seebeck coefficient and resistivity of the 50 mole percent cuprous sulfide-cuprous phosphide system are presented in the temperature range of 1,000° to 1,200° C. Author

N64-26701 Michigan U., Ann Arbor Electron Physics Lab.
SOLID-STATE MICROWAVE RESEARCH Interim Scientific Report No. 2, Feb. 1–Apr. 1, 1964
D. C. Hanson, J. E. King, J. E. Rowe, and C. Yeh Apr. 1964 33 p refs
(Contract AF 33(657)-11587)
(Rept.-06031-2-S; AD-437935)

Various electron paramagnetic resonance experiments are reviewed in an effort to determine those materials most appropriate for parametric phonon interactions. One of the most promising materials is $CdS:V^{3+}$ since the nuclear spin of 7/2 associated with the V^{51} isotope splits each fine line into eight lines. This results in a linewidth for absorption of approximately 700 gauss that is a 10% bandwidth at X-band. The use of X-cut longitudinal quartz transducers resonant in the 5 to 40-mc region has allowed the observation of echoes up to 577 mc at room temperature. Similar results were obtained up to 400 mc at liquid nitrogen temperature. The theory of stimulated Bremsstrahlung radiation from solids is developed further with particular emphasis on ionized impurity scattering. Experimental observation of significant powers at microwave frequencies can possibly be explained as a result of Raman scattering by optical phonon vibrational modes due to coupling with the previously postulated radiation and subsequent down conversion to microwave frequencies. Acoustic gain and velocity characteristics were calculated for longitudinal mode excitation as a function of the velocity parameter u_o/v. Furthermore a general $\omega-k$ relation is derived. Possible Alfvén wave interactions in semiconductors are investigated. Author

N64-26727 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CRYSTALLIZATION AND PHASE TRANSITIONS Selected Articles
15 May 1964 12 p refs Transl. into ENGLISH from Krist. i Fazovyye Perekhody (USSR), 1962 p 58–61, 66–70
(FTD-TT-161/1+2; AD-601759)

CONTENTS:

1. DIRECT MEASUREMENT OF THE INTERPHASE SURFACE ENERGY ON THE CRYSTAL-FUSION BOUNDARY F. K. Gorskiy p 1–5 refs

2. DETERMINATION OF THE TEMPERATURE DEPENDENCE OF THE ENERGY OF ACTIVATION OF THE GROWTH OF A NEW PHASE L. O. Meleshko p 6–9 refs

N64-26808* Pratt and Whitney Aircraft, East Hartford, Conn.
DETERMINATION OF THE EMISSIVITY OF MATERIALS Annual Progress Report, 1 Jan.–31 Dec. 1963
[1963] 170 p ref
(Contract NASw-104)
(NASA-CR-58054; PWA-2309) OTS: $12.00 ph

A screening rig was constructed to enable evaluation of coating behavior at elevated temperatures so that coating volatilization in the emittance rigs could be avoided. Three materials were tested to date— Kennametals K-151A and K-1628, and iron titanate. The Kennametals were found to be stable up to 1,600° F and the iron titanate up to 2,000° F. Emittance values were obtained for several materials and were compared with previously obtained values to determine reproducibility. Tests of four coated radiator segments exposed to temperatures between 650° and 700° F and vacuum for periods ranging from 12,700 to 15,000 hours were completed, and a post test analysis was made. Methods for applying silicon carbide coatings by aluminum phosphate bonding were investigated, but, although some improvement was realized, a satisfactory technique was not developed. Author

N64-26848 Rochester U., N.Y.
THEORETICAL STUDIES OF THE ELECTROMAGNETIC FIELD IN THE FOCAL REGION OF COHERENT LIGHT BEAMS Progress Report, Oct. 1, 1963–Mar. 31, 1964
Emil Wolf [1964] 6 p refs
(Grant DA-ARO(D)-31-124-G-325)
(PR-3- AD-603530)

Topics investigated include electromagnetic diffraction in the focal region of an aplanatic optical system, fluctuations of light beams, and phase space formulation of the dynamics of canonical variables. D.E.W.

N64-26850 General Electric Co., Syracuse, N.Y. Electronics Lab.
RESEARCH ON MICROWAVE INTERACTIONS IN SEMICONDUCTORS
R. W. Aldrich, C. R. Boyd, J. P. Dietz, and S. Wanuga 15 Dec. 1963 47 p
(Contract AF 33(657)-10088)
(QR-4; AD-603521)

This study has two tasks—the first has as its objective to produce and evaluate distributed semiconductor structures; the second task consists of a study of solid-state ultrasonic amplifiers and of the evaluation of design methods and principles for such devices. Improved test apparatus made possible measurements on one of the diodes fabricated during the previous quarter. A phase shift of 9°, with an accompanying loss of 6 db, was measured. The calculated diode cutoff frequency is 2 kmc/s. Some experiments with electrodes, and with alternative diode diffusion processes were made. No diodes were completed. The initial objective of the work on the acoustic amplifier that was to obtain net gain was achieved. An experimental amplifier exhibiting 51-db acoustic gain and 23-db insertion gain was demonstrated. The specific unit used CdS as the interacting medium, operates in pulsed condition centered at 48.5 mc, and has a −3-db bandwidth, limited by the transducers, of approximately 4%. Author

N64-26854 Harvard U., Cambridge, Mass. Gordon McKay Lab.
TRANSPORT PROPERTIES AND BAND STRUCTURE OF GRAY TIN
Steven H. Groves Dec. 1963 151 p refs
(Contract Nonr-1866(10))
(HP-10; AD-432897)

A model was constructed for the purpose of investigating the dependence of the electrical conductivity and Hall coefficient of a particular energy gap depends on the symmetry of the electron states involved, but varies little from material to material. The $\Gamma^{-} \approx \Gamma^{+}$ gas is systematically extrapolated from CdTe and InSb to gray tin. This extrapolated energy gap is negative, which is intrepreted to mean that the Γ^{-} state is lower in energy than the Γ^{+} and, consequently, the valence-band maximum and conduction-band minimum are degenerate, with Γ^{+} symmetry. Thus, the thermal energy gap is fixed at zero, independent of temperature and pressure. The model proposed is compatible with the results of other experiments; in particular, from the value of the Γ^{-}–Γ^{+} energy gap, extrapolated from the CdTe and InSb gaps, a (000) conduction band effective mass was calculated by the k ' p method. This effective mass is in good agreement with the measured value. It is suggested that the proposed band structure may apply to some other materials. I.v.L.

N64-26895 Notre Dame U., Ind.
RESEARCH ON THE PRODUCTION AND PHYSICS OF SINGLE CRYSTAL EMITTERS Final Report
E. A. Coomes 20 Apr. 1964 29 p refs
(Contract AF 19(604)-8434) Final Report
(AFCRL-64-410; AD-602713)

Single crystals of tungsten and molybdenum from 1 to 10 cm long were produced by the Robinson-plus-torsion technique in 4 to 5 mil filaments. These were studies in an improved electron projection diode, in which point-by-point and average thermionic constants could be measured on the same filament. The work functions for various directions of single crystal molybdenum were found to be the same as those for single crystal tungsten. Also, the average values of work function ϕ^{R} and A^{R} were 4. 40 and 40, respectively, for both tungsten and molybdenum. Thermal treatment always developed facets on the crystal areas of high work function. These facets had highest thermal stability when a shingled structure developed on them during heating. Author

N64-26898 University Coll., Cardiff (Gt. Brit.)
RESEARCH ON RECOMBINATION FLUCTUATION THEORY IN SEMICONDUCTORS Scientific Report No. 1, Feb. 1963–30 Apr. 1964
P. T. Landsberg and D. A. Evans 31 May 1964 6 p refs
(Contract AF 61(052)-664)
(AFCRL-64-564; AD-603090)

Research discussed includes these areas: (1) Expressions were derived in a previous publication for the frequency distributions of the fluctuations in the number of electrons and holes, arising from the statistical nature of the recombination and generation processes, in a semiconductor in equilibrium. These expressions were extended to the case in which recombination centers that are present can trap more than one electron, and in which the centers that have trapped different numbers of electrons must be assigned different quasi-Fermi levels (i.e., are not in effective equilibrium with each other) in a non-equilibrium state. (2) Hole lifetimes were measured in n-type Ge at different doping levels in the presence of a fixed concentration of Cu recombination centers. (3) The excess positive or negative) concentrations will decay to zero in a manner determined by the different recombination and generation mechanisms available, if the concentration of electrons or holes in a homogeneous semiconductor is different from its equilibrium or steady-state value under the conditions obtained. Theoretical predictions of the time-dependance of this decay have been obtained for cases in which the two single-electron- and four-electron-collision mechanisms, associated with recombination centers with each center being able to trap one electron, are the most important mechanisms. I.v.L.

N64-26908 Chalmers U. of Tech., Goteborg (Sweden) Research Lab. of Electronics
THE MAGNETO-IONIC THEORY FOR MASS ANISOTROPIC ELECTRONS
K. H. B. Wilhelmsson 1 Apr. 1964 43 p refs
(Contract AF 61(052)-451)
(RR-47; AFCRL-64-535; TN-US-41; AD-603087)

The purpose of the investigation was to develop the magneto-ionic theory for mass-anisotropic electrons, assuming a general tensor form of the effective mass. Since collisional phenomena in solid materials play an important role, such effects by formally introducing an effective collision frequency were considered. Author

N64-26918 Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
FAILURE MECHANISMS AT METAL-DIELECTRIC INTERFACES
K. F. Greenough Griffiss AFB, N.Y., RADC., Jul. 1964 47 p refs
(Contract AF 30(602)-3266)
(RADC-TDR-64-138; AD-603279)

The interface between a metal-film electrode and a thin-film dielectric was identified as the one model system most

representative of the type of material interface found in thin film solid-state devices and integrated electronic thin-film circuitry. Several thin-film gas plated, glass dielectric capacitor model systems were fabricated with combinations of aluminum, gold, and nickel electrode-dielectric interfaces and were electrically characterized. Thin film glass capacitors fabricated with oxygen active metal electrodes (i.e., aluminum and nickel) exhibit lower loss, smaller frequency dispersion of capacitance, and lower temperature sensitivity of capacitance and dissipation factor than identical capacitors fabricated with an inert metal electrode of gold. Capacitor dielectrics vacuum baked before deposition of the metal film electrode exhibit optimum electrical characteristics. Exposure of the dielectric surface to ambient conditions or high humidity environments degrades the initial characteristics of the completed capacitor. Procedures for the use of radioactive isotopes to study diffusion phenomena across metal-dielectric interfaces are described. Author

N64-26919 Tyco Labs., Inc., Waltham, Mass.
STUDY OF SURFACE STATES IN SEMICONDUCTORS
G. Rupprecht and J. Gilbert Griffiss AFB, N.Y., RADC, Jul. 1964 23 p
(Contract AF 30(602)-3157)
(RADC-TDR-64-168; AD-603262)

The study of surface state in III to V compounds was terminated. This report presents pertinent experimental procedures, results, and a discussion of surface states on surfaces of GaAs. For n-type undoped GaAs, pulsed field effect measurements on the β face yield two levels—$E_1 = 0.56$ ev below the conduction band with a capture cross section of the order of $\sigma_1 \approx 10^{-12}cm^2$ and $E_2 = 0.13$ ev below the conduction band with a capture cross section for electrons $\sigma_2 \approx 10^{-22}cm^2$. Level E_1 appears to be a donor state, whereas E_2 is identified as an acceptor state. The *A* face yields a distribution of states of energies in the range of 0.2 ev and 0.6 ev below the conduction band. One level, 0.51 below the conduction band with a capture cross section for electrons of $10^{-14}cm^2$, agrees within experimental error with the E_1 level on the *B* face. A correlation between surface state activity and dislocation etch pit density is discussed, and further studies are outlined. Author

N64-26938 Sperry Microwave Electronics Co., Clearwater, Fla.
DEVELOPMENT OF ADVANCED MICROWAVE COMPONENTS AND TECHNIQUES—PLANAR HEXAGONAL FERRITES AND DEVICES
Joseph M. Schenna Griffiss AFB, N.Y., RADC Jun. 1964 36 p refs
(Contract AF 30(602)-2757)
(RADC-TDR-64-242; AD-602835)

Efforts to reduce the dielectric loss tangent of planar hexagonal ferrites through the use of iron deficient compositions produced only marginal improvements in the Zn_2Y materials, and no observable improvement in the loss tangent of $Cu_{0.75}Zn_{1.25}Y$. When iron deficiencies of as much as 10% are used, diffraction lines corresponding to crystal structures other than the Y structure are seen. X-ray diffraction studies of nickel ferrite pressed in the presence of a d.c. magnetic field have shown positive evidence of crystallite orientation. Narrowest X-band linewidth measured on this partially oriented nickel ferrite is 268 oe. An analysis of the application of planar hexagonal ferrites in phase shifters, with consideration given to their ultimate use in switching devices, is reported. The effect of dielectric loading on planar hexagonal ferrite phase shifters is also discussed. Effects of the planar anisotropy field on the performance of differential phase shifters is determined, and this anisotropy field is shown to have a detrimental effect on phase shifter operation. Some measurements on the response of phase shifters using planar hexagonal ferrites at C- and X-band are given. The hysteresis loop parameters of the planar hexagonal ferrites are reported. The lowest coercive field measured was twice or three times higher than was measured on cubic materials. The highest squareness ratio obtained is 0.85. Author

26 PROPELLANTS AND COMBUSTION

Includes fuels; igniters; and oxidizers. *For related information see*: 07 Chemistry; and 27 Propulsion.

N64-25875* Israel Program for Scientific Translations, Ltd., Jerusalem.
SELF-IGNITION, FLAME AND DETONATION IN GASES
A. S. Sokolik 1963 465 p refs Transl. into ENGLISH of the book "Samovosplamenenie, Plamya i Detonatsiya v Gazakh" Moscow, Izd. Akad. Nauk SSSR, 1960
(Sponsored by NASA and NSF)
(NASA-TT-F-125; OTS-63-11179) OTS: $4.75

The following subjects are covered: (1) self-ignition—thermal and chain-thermal explosion, self-ignition of hydrocarbons, and hydrocarbon ignition at high pressures; (2) flame—laminar flames and turbulent combustion; and (3) detonation in gases—theory of shock and detonation waves and detonation and self-ignition in engines. P.V.E.

N64-25889 Aerojet-General Corp., Azusa, Calif.
RESEARCH ON NEW TECHNIQUES FOR ANALYSIS OF CONTAMINANTS IN LIQUID PROPELLANTS
R. M. Roberts and J. R. Finkel Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Mar. 1964 87 p refs
(Contract AF 33(657)-7936)
(Rept.-2638; APL-TDR-64-3; AD-437979)

This program was a several-phased effort aimed at improving the state-of-the-art of propellant-contamination surveillance. Detectable contaminants in 12 different storable propellants were characterized, and coherent gaschromatograph methods were developed for their analysis. The end item, an automatic gas chromatograph for launch-site employment, was then designed and fabricated to incorporate this developed methodology. Author

N64-25991 Pennsylvania State U., University Park College of Engineering
FUEL PRECONDITIONING AS A MEANS FOR CONTROLLING COMBUSTION CHARACTERISTICS IN COMPRESSION IGNITION ENGINES Final Report
J. J. de Carolis and W. E. Meyer 31 Mar. 1964 92 p refs
(Contract DA-36-034-ORD-3491RD)
(AD-439496)

A literature review and an analysis of possible approaches to fuel preconditioning for improving multifuel operation of diesel engine are presented. Two methods that improve the combustion of inferior diesel fuels the most are the early introduction of a portion of the fuel normally introduced and local high energy sources. The beneficial effects of the first method for either reducing exhaust smoke, controlling pressure rise, increasing combustion efficiency, or increasing engine output

were investigated by many researchers. Their results indicate that combustion in many applications can be improved, but not to the extent necessary for allowing multifuel operation of engines not having basic multifuel capability. Local energy sources seem to offer the best possibility for obtaining a sufficiently short ignition lag with all fuels for rendering engines insensitive to fuel ignition quality. The importance of controlling ignition lag lies in that it controls the inflammation phase of the combustion process. The method of promoting ignition by a local energy source was not thoroughly explored because of the lack of suitable instrumentation. It is only with present day instrumentation technology that this can be accomplished. Equipment and instrumentation proposed for studying hot surfaces for promoting combustion in compression ignition engines are presented. Author

N64-26003 Advisory Group for Aeronautical Research and Development, Paris (France)
NONSTEADY FLAME PROPAGATION
George H. Markstein (Cornell Aeron. Lab.) Oxford, N.Y., Pergamon, 1964 338 p refs
(AGARDograph-75) Pergamon: £5 10 s

CONTENTS:

1. THEORY OF FLAME PROPAGATION G. H. Markstein (Cornell Aeron. Lab., Inc.) p 5–14 refs (See N64-26004 18-26)
2. PERTURBATION ANALYSIS OF STABILITY AND RESPONSE OF PLANE FLAME FRONTS G. H. Markstein p 15–74 refs (See N64-26005 18-26)
3. EXPERIMENTAL STUDIES OF FLAME-FRONT INSTABILITY G. H. Markstein p 75–103 refs (See N64-26006 18-26)
4. FLAME PROPAGATION IN TUBES AND IN CLOSED VESSELS H. Guenoche (Aix-Marseilles) p 107–181 refs (See N64-26007 18-26)
5. GENERAL CONSIDERATIONS OF AUTONOMOUS COMBUSTION OSCILLATIONS A. A. Putnam (Battelle Mem. Inst.) p 183–198 refs (See N64-26008 18-26)
6. EXPERIMENTAL AND THEORETICAL STUDIES OF COMBUSTION OSCILLATIONS A. A. Putnam p 199–290 refs (See N64-26009 18-26)
7. PRACTICAL CONSIDERATIONS OF COMBUSTION OSCILLATIONS A. A. Putnam p 291–314 refs (See N64-26010 18-26)

N64-26004 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
THEORY OF FLAME PROPAGATION
G. H. Markstein *In* AGARD Nonsteady Flame Propagation 1964 p 5–14 refs (See N64-26003 18-26) Pergamon: £5 10 s

The theory of propagation of a flame front through a combustible gas mixture is based on the laws of conservation of mass, momentum and energy, and additional continuity conditions for each individual chemical species that participates in the reaction. The latter equations and the energy equation contain terms representing the rate of creation or destruction of species and the rate of energy release by chemical reactions. G.D.B.

N64-26005 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
PERTURBATION ANALYSIS OF STABILITY AND RESPONSE OF PLANE FLAME FRONTS
G. H. Markstein *In* AGARD Nonsteady Flame Propagation 1964 p 15–74 refs (See N64-26003 18-26) Pergamon: £5 10 s

Discussed is the linearized treatment for small perturbations of flow field and flame shape. An analysis of finite-amplitude flame cells is presented. G.D.B.

N64-26006 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
EXPERIMENTAL STUDIES OF FLAME-FRONT INSTABILITY
G. H. Markstein *In* AGARD Nonsteady Flame Propagation 1964 p 75–103 refs (See N64-26003 18-26) Pergamon: £5 10 s

Spontaneous instability in steady flow is discussed. Given are results of studies of instability by means of artificially disturbed burner flames. The instability in vibratory flow and that due to interaction of shock waves with flame fronts are considered. G.D.B.

N64-26007 Aix-Marseilles U. (France)
FLAME PROPAGATION IN TUBES AND IN CLOSED VESSELS
H. Guenoche *In* AGARD Nonsteady Flame Propagation 1964 p 107–181 refs (See N64-26003 18-26) Pergamon: £5 10 s

Flame propagation is discussed in terms of propagation in tubes and in a spherical chamber. When a source of ignition liberates enough energy during a period of time short enough for the active centers formed in the combustible medium to be distributed in a suitable volume and to possess enough energy, a flame occurs in the medium in question and begins to propagate. This study considers the parameters in the ignition of a gaseous mixture—the energy dissipated in the medium, the time during which this energy is transferred to the medium, and the volume in which the energy is dissipated. G.D.B.

N64-26008 Battelle Memorial Inst., Columbus, Ohio
GENERAL CONSIDERATIONS OF AUTONOMOUS COMBUSTION OSCILLATIONS
A. A. Putnam *In* AGARD Nonsteady Flame Propagation 1964 p 183–198 refs (See N64-26003 18-26) Pergamon: £5 10 s

System instability, acoustical instability, transition instability, energy sources for combustion oscillations, theoretical approach to problems of combustion oscillations, and Rayleigh's criterion of driving are all discussed. In some instances, the lines of demarcation are not clear. Transition and system instability may be easily confused in certain instances. The energy by which the oscillation is driven may stem from several sources. G.D.B.

N64-26009 Battelle Memorial Inst., Columbus, Ohio
EXPERIMENTAL AND THEORETICAL STUDIES OF COMBUSTION OSCILLATIONS
A. A. Putnam *In* AGARD Nonsteady Flame Propagation 1964 p 199–290 refs (See N64-26003 18-26) Pergamon: £5 10 s

This paper gives the results of a number of studies of organ-pipe oscillations and transverse oscillations in combustion systems. The studies are divided according to the basic arrangement of the components of the combustion unit. G.D.B.

N64-26010 Battelle Memorial Inst., Columbus, Ohio
PRACTICAL CONSIDERATIONS OF COMBUSTION OSCILLATIONS
A. A. Putnam *In* AGARD Nonsteady Flame Propagation 1964 p 291–314 refs (See N64-26003 18-26) Pergamon: £5 10 s

Experimental studies of suppression methods are considered. Taking the positive point of view that oscillations can be useful, various possible applications of autonomous combustion oscillations are outlined. G.D.B.

N64-26020 Naval Air Test Center, Patuxent, Md.
FIT CHECK AND FLIGHT TEST OF THE UNIVERSAL AIR REFUELING DROGUE Final Report
21 May 1964 7 p
(ST31-53R-64; AD-600677)

The results of an evaluation of a prototype universal air-refueling drogue are presented. The purpose of the evaluation was to determine the compatibility of the drogue with all Navy air-refueling systems and to evaluate maintainability. It was found that the universal air refueling drogue was not suitable for service. P.V.E.

N64-26063 Canadian Armament Research and Development Establishment, Valcartier

BALLISTIC REPRODUCIBILITY OF THE 9KS11000 ROCKET MOTOR FOR THE BLACK BRANT III VEHICLE

F. Jackson and W. G. Brownlee Dec. 1963 31 p refs (CARDE-TR-464/63)

A statistical analysis of results from development rounds, coupled with confirmatory small-scale motor firings, has established that excessive scatter of performance data from 9KS11000 motor firings was mainly due to variations in the level of the anticaking agent in the ammonium perchlorate. To demonstrate the maximum degree of reproducibility attainable with current procedures, a series of five motors were manufactured from single lots of raw ingredients. These motors were made to a standard design specification and were fired at a fixed initial grain temperature. The reduced scatter in specific impulse and characteristic velocity from these rounds was comparable with values obtained throughout the solid-propellant industry. The statistical method employed to examine the data from development round firings is described; the results of a multiple linear regression analysis of these data are compared with those obtained from firings of small-scale motors in which the level of anticaking agent in the oxidizer had been deliberately varied. Ballistic data from the five rounds of the reproducibility series, including pressure and thrust-time readings, are also presented. Author

N64-26149 Cornell U., Ithaca, N.Y. Graduate School of Aeronautical Engineering

A MEASUREMENT OF THE RECOMBINATION RATE OF OXYGEN

J. Wilson *In* AGARD The High Temp. Aspects of Hypersonic Flow 1964 p 471–483 refs (See N64-26126 18-11)

The recombination rate of oxygen was measured in a shock tube. The shock tube is unconventional in that airfoils have been inserted to expand the flow and a constant-area channel placed behind the airfoils; thus the shock tube is effectively a low-expansion-ratio shock tunnel. The gas in the tube is first dissociated and set in motion by the shock wave, then flows through the expansion waves created by the airfoils and is cooled, and finally flows into the constant-area channel, where it recombines. Shock waves between M = 7.5 and M = 9.5 in mixtures of oxygen and argon at 2-cm-Hg pressure are used, giving degrees of dissociation between 0.1 and 0.4. The temperature drop across the expansion is about 700° K. Measurement of the degree of dissociation downstream of the expansion leads to the recombination rate. The means of measurement is absorption of ultraviolet light at a wavelength of 2,283 A. The rate constants for recombination are compared with those obtained by reflecting the known dissociation-rate constants through the equilibrium constant. Author

N64-26227 Picatinny Arsenal, Dover, N.J. Feltman Research Labs.

CHARACTERISTICS OF CONDUCTIVE EXPLOSIVE MIXTURE CONTAINING MODERATE AMOUNTS OF ALUMINUM

Henry J. Jackson Jul. 1964 22 p refs (TM-1337; AD-602620)

An examination of some of the parameters affecting the electrical initiation of a conductive explosive mixture was made. The conductive mixture was RDX/ aluminum 80/20. Some parameters were arbitrarily held constant, since the effort was concentrated on parameters that were considered most critical in the initiation. The effects of energy, voltage, and power were studied. The tests show that, for a given condition, power is an important factor. Also that for a given energy, there is a critical voltage and capacitance for effective energy transfer. The results also showed that the diameter and column length of the conducting layer are related to the probability of fire for a given applied energy and loading pressure, and that a mathematical expression of this relationship, when plotted, gives a normal sensitivity curve. Author

N64-26329 Rrance. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux

SUPERSONIC COMBUSTION IN A CYLINDRICAL CANAL [COMBUSTION SUPERSONIQUE DANS UN CANAL CYLINDRIQUE]

Andre Mestre and Louis Viaud *In* AGARD Supersonic Flow, Chem. Processes and Radiative Transfer 1964 p 93–111 refs In FRENCH (See N64-26326 18-11) Pergamon: £9

Combustion of kerosene in a flow of air occurred in a cylindrical channel of 90-mm diam and 50-cm and 2-m long. Preheating the air for combustion, with restoration of the oxygen, permitted flight simulation at Mach 6.4 and at 34-km altitude. Conditions of entry to the combustion chamber were defined as Mach 2.48, 0.277 bars pressure, and 1,100° K. The pressures were raised the length of two generators and, for cooled probes, in the outlet section of the combustion chamber. The spontaneous ignition of the mixture and a stable combustion were obtained within narrow limits of richness; the thermal obstruction carries away extinction from the nozzle at this rapidly reached low Mach number. Analysis of the calculation showed a noticeable deviation coming partly from the experimental conditions and, in particular, from the energetic cooling of the walls—25% of the heat liberated by the combustion being thus removed. It equally appears that the one-dimensional scheme of flow introduced into the calculation is very far from reality. Nevertheless, the overall balance, losses of stopping pressure, and combustion yield, deduced from these trials, allow a possible application to a static hypersonic reactor. Trans. by D.E.W.

N64-26339 Western Ontario U., London (Canada)

LABORATORY ASTROPHYSICS AND COMBUSTION SPECTROSCOPY

R. W. Nicholls *In* AGARD Supersonic Flow, Chem. Processes and Radiative Transfer 1964 p 413–430 refs (See N64-26326 18-11)

(Grant AF-AFOSR-62-236) Pergamon: 9 £

The similarities between the methods and concepts of astrophysics and of quantitative combustion spectroscopy are discussed, with special reference to radiative properties of hot gases. New transition probability data are presented and discussed for the CN Violet, CN Red, C_2 Swan and OH Violet band systems. Author

N64-26340 Institut Franco-Allemand de Recherches, St. Louis (France)

THERMAL RADIATION OF A FLAME WITH CONDENSED MgO PARTICLES

Fritz Rossler *In* AGARD Supersonic Flow, Chem. Processes and Radiative Transfer 1964 p 433–438 refs (See N64-26326 18-11) Pergamon: 9 £

Solid rocket propellants and explosives often contain metallic additives that are oxidized and radiate as solid particles in a flame. Aluminum and magnesium are the most commonly

used metallic additives. Calculations have not yet been carried out because of the strong scattered radiation. However, success was attained in considering two fluxes of radiation in opposite directions. Two simultaneous differential equations allow an explicit solution. The brightness and color temperatures of such flames can be calculated. To demonstrate the method, published data of a stationary MgO frame are interpreted by the resulting equations. Author

N64-26485 Bureau of Mines, Pittsburgh, Pa. Explosives Research Center
SENSITIVITY CHARACTERISTICS OF LIQUID EXPLOSIVE SYSTEMS Progress Report, 1 Apr.–30 Jun. 1964
Frank C. Gibson, John Riborich, and J. Edmund Hay Jul. 1964 16 p refs
(BuWEPS Order IPR-19-64-8026-WEPS)
(PR-10)

This paper reports efforts designed to evaluate hazards associated with high-energy liquid explosives and explosive systems. Emphasis was placed on developing new techniques for continuously following the development of both high-velocity and low-velocity detonations. Probes have been devised to distinguish between inert shocks and reaction pressure waves in the liquid. A shock sensitivity scale for comparing casting solvents has been established with the nitroglycerin–Ethyleneglycol dinitrate–triacetin system. N.E.A.

N64-26632 Canadian Armament Research and Development Establishment, Valcartier
THE INFLUENCE OF AXIAL COMBUSTION INSTABILITY ON THE DEVELOPMENT OF A 23KS20000 MOTOR
F. Jackson, W. G. Brownlee, and A. K. Roberts Apr. 1964 11 p refs Presented at Fourth Mdeting of the Tech. Panel on Solid Propellant Instability of Combust., Menlo Park, Calif., 1 Feb. 1964
(CARDE-TN-1620/64)

Axial combustion instability was found to be the limiting factor in the development of a 17-in.-diam–180-in.-long 23KS-20000 motor. The ensuing applied research investigations at CARDE led to a clear phenomenological description of finite wave axial combustion instability. This knowledge was used to overcome the adverse design limitations initially imposed on the 23KS20000 motor. Author

N64-26636 Canadian Armament Research and Development Establishment, Valcartier
A PLATE-DENT MEASUREMENT OF THE INITIATING EFFICIENCY OF A DETONATOR
G. R. Walker Jan. 1964 14 p refs Presented at Intern. Conf. on Sensitivity and Hazards of Explosives, London, 1–3 Oct. 1963
(CARDE-TR-476/63)

The gap test has been used extensively to measure the sensitivity of a receptor explosive by determining the thickness of an inert attenuator for which a given donor explosive produces a detonation in the receptor. Such a test was used with a detonator as the donor to measure its initiating efficiency. Test components were designed and assembled to simulate the essential features of a particular military munition. By assuming a normal distribution of all factors, the probability of functioning in a standard munition can be estimated by extrapolating the normal curve to zero gap. Results are very reproducible and correspond well with similar measurements using actual military items. Author

N64-26642 Aerojet-General Corp., Sacramento, Calif.
NEW DEVELOPMENTS IN CONTINUOUS PROPELLANT PROCESSING FOR THE POLARIS PROPULSION SYSTEMS Report Period Ending Nov. 1963
L. G. Schwieger 19 Dec. 1963 41 p
(Contract Nord-18171)
(Rept.-0178-07M-10; AD-437752)

Both the nondispersive X-ray and reflectance refractometer were moved to the pilotplant. The units are undergoing final evaluation tests, and specific results are presented on Brabender produced propellant for the reflectance refractometer. The response equations and the theoretical controller settings on the oxidizer feeder of the oxidizer loop are presented. R.T.K.

N64-26666 Rocketdyne, Canoga Park, Calif.
DENSE PHASE TRANSPORT OF POWERED METALS FOR A TRIPROPELLANT ROCKET SYSTEM
H. L. Burge, R. W. Roberts, and E. V. Zettle 21 Oct. 1963 31 p ref Presented at the AICHE Meeting, Houston, Tex., 1–5 Dec. 1963

The feasibility of adding a light metal to a rocket thrust chamber as a third propellant in a cryogenic engine to increase potential payload is discussed. The combustion process was analyzed in terms of the theoretical requirements for burning light metal and efficiently transferring the generated heat to hydrogen injected into the chamber as a working gas. The theory of fluidized metal transport, which is important to rocket engine application, is discussed, and preliminary experiments are presented. These experiments have conclusively demonstrated the feasibility of transport solid particles with a fluidizing gas (hydrogen) with weight ratios (W_S/W_g) up to 150/1.
Author

N64-26679 British Internal Combustion Engine Research Assn., Slough (Gt. Brit.)
COMBUSTION IN DIESEL ENGINES Quarterly Technical Status Report No. 2, 1 Nov. 1963–31 Jan. 1964
D. W. Tryhorn 20 Feb. 1964 3 p
(Contract DA-91-591-EUC-2974)
(WR-1315; AD-439447)

The Gardner 1 L2 engine (C) was developed to run under simulated pulse-turbocharged conditions up to 200 psi bmep. The engine was tun at 1,250 rpm with boost pressure, temperature (obtained from cylinder pressure diagrams and airflow readings), and fuel-to-air ratio, as near as possible to the values obtained from previous tests on the Tangye engine (B). In this way, as well as that of showing the effect of compression temperature on combustion in an engine with a conventional direct injection system, it was possible to compare directly the combustion characteristics of the two engines (B) and (C). The engine (C) was run at 1,600 rpm and then at 1,950 rpm, using both warm and cool charge, to obtain the effect of engine speed on combustion at the same two levels of compression temperature. R.T.K.

N64-26739 Instituto Nacional de Technica Aeronautica, Madrid (Spain)
UNIDIMENSIONAL THEORY OF SUPERSONIC COMBUSTION
I. Da-Riva 1 May 1963 21 p refs
(Grant AF-EOAR-62-91)
(AFOSR-5260; AD-416528)

This paper outlines a generalized unidimensional theory of supersonic combustion. It considers a stream of oxidizer flowing along a tube with lateral fuel supply governed by a

certain injection law and the combustion occurring in conditions in which the pressure is kept constant. If the injecting of fuel does not impart kinetic-energy to the flow, the mixing process, even supposing it takes place in ideal conditions, appreciably lowers the upper limit to the practicability of supersonic combustion (the dissociation limit). As for the lengths required for combustion to take place, the estimate arrived at by this method is practically the same as that obtained by assuming that the mixing and the reaction are two independent processes. In most of the cases considered the diffusion governs the process; in other words, the flow is closer to chemical-equilibrium than to frozen flow conditions. Author

N64-26785* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
THERMODYNAMIC AND TRANSPORT PROPERTIES FOR THE HYDROGEN-OXYGEN SYSTEM
Roger. A. Svehla Washington, NASA, 1964 423 p refs
(NASA-SP-3011) OTS: $6.00

Calculations were made of the thermodynamic and transport properties of the hydrogen–oxygen system. The properties calculated include enthalpy, entropy, molecular weight, heat capacity isentropic exponent, composition, viscosity, thermal conductivity, and Prandtl number and Lewis number for chemical equilibrium conditions. Also included were frozen heat capacity, frozen thermal conductivity, and frozen Prandtl number, all calculated with the equilibrium composition. Results are presented in tabular form, and, in some cases, in graphical form. R.T.K.

N64-26818 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ABOUT A CERTAIN METHOD OF INVESTIGATING COMBUSTION CHAMBERS
R. Szymanik and R. Staniszewski 12 Jun. 1964 12 p refs Transl. into ENGLISH from Arch. Budowy Maszyn (Warsaw), v. 10, no. 3, 1963 p 239–247
(FTD-TT-64-616/1+2; AD-442442)

In this report a method is described for theoretically and experimentally investigating combustion chambers. Introducing a solution for heat equation and an expression for the disturbance of the combustion process to the Duhamel integral, the relationship was found between the parameters in the chamber and the thermal parameters on the outer surface (measured surface) of the wall. The problem was reduced to the solution of integral equation of the Volter type. Author

N64-26856 Pennsylvania State U., University Park Coll. of Engineering and Architecture
FLAME TRAJECTORY AND ITS EXPERIMENTAL DETERMINATION IN VORTEX COMBUSTION. VORTEX CONTROLLED MULTIFUEL COMBUSTION Technical Report No. 2
Youngson Lee May 1963 123 p refs
(Contract DA-36-ORD-3366-T)
(TR-L; AD-408928)

A rotating, cylindrical combustion chamber was used to observe the effect of chamber rotative speed and location of the point of ignition on combustion duration and flame trajectory in a cylindrical force field. Experimental trajectories of the flame in homogeneous and nonhomogeneous mixtures were compared with analytically obtained ones. The optimum location of the point of ignition is at the periphery of the combustion chamber for both homogeneous and nonhomogeneous gas mixtures because this flame origin produces the strongest vortex. Combustion of a nonhomogeneous gas mixture provides greater time rates of energy emission than that of a homogeneous mixture. Combustion of a homogeneous mixture, however, produces a stronger swirl than that of a nonhomogeneous mixture when both are overrich. At the beginning of the combustion the experimentally observed trajectories of the flame coincide with the theoretically determined trajectories, but in the later portion of the combustion they do not because the drag on the inflamed portion of the mixture exceeds that predicted by theory. Author

N64-26865 Frankford Arsenal, Philadelphia, Pa.
FORM FUNCTIONS FOR DUAL COMPOSITION INCREMENTS OF PROPELLANT GRAINS
J. F. Vowalick and M. S. Silverstein Sep. 1963 20 p ref
(R-1692; AD-603520)

It is mathematically demonstrated that any desired form function can be approached by the burning of increments or groups of dual composition propellant grains of neutral geometry (constant surface during burning). This scheduled burning is achieved by varying the thickness of each of the outer layers of propellant, with the outer layers having the lower burning rate. The pertinent parameters are the total burning distance of the propellant system, the burning distances of grains in each increment of propellant, the number of groups or increments, the mass of each group, and the number of groups that are burning simultaneously. The relationship of these parameters to the desired form function is expressed as a series of equations, each of which is an incremental form function. The sum of the series approaches, to any desired degree of accuracy, the specified form function. Author

27 PROPULSION

Includes airbreathing, electric, liquid, nuclear, and solid propulsion. *For related information see*: 04 Aircraft; 06 Auxiliary Systems; 26 Propellants and Combustion; and 30 Space Vehicles.

N64-25907* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
EXPERIMENTAL SYSTEMS STUDIES OF LARGE MODULES AND ARRAYS OF ELECTROSTATIC THRUSTORS
Paul D. Reader and William R. Mickelsen Washington, NASA, 1964 19 p refs Presented at the First AIAA Ann. Meeting and Tech. Display, Washington, 28 Jun.–2 Jul. 1964
(NASA-TM-X-52019) OTS: $1.60 ph

Performance characteristics and power requirements of existing electron-bombardment thrustors are presented in a form useful to electric-propulsion-system analysis and design. This information is based on experimental operation of laboratory thrustor modules of 5 to 50 cm in diameter and module and array power levels up to 30 kw. Designs are shown for two multidirectional, nongimbaling thrustors of the size appropriate for satellite station keeping and attitude control. Static and dynamic controls characteristics of electron-bombardment thrustors are summarized. A thrustor circuit design is described that suppresses electric breakdowns to a magnitude sufficiently small to eliminate damaging interaction between the thrustor and the power-conversion system. Author

N64-25989 Martin Co., Denver, Colo.
TITAN II TRANSLATION ROCKET MOTOR THRUST VARIATION ANALYSIS
C. C. Hartman 15 May 1964 35 p
(Contract AF 04(647)-576)
(CR-64-113; AD-600622)

The thrust variation of the Titan II translation motor has been determined, on the basis of 87 firing tests, to be ±250 lb under vacuum conditions at 60° F. Analysis of the thrust variation indicates the primary cause is variation in propellant burning rate arising from allowable tolerances in propellant composition. Author

N64-26102 ARO Inc., Arnold Air Force Station, Tenn.
INFLUENCE OF PERTINENT PARAMETERS ON EJECTOR-DIFFUSER PERFORMANCE WITH AND WITHOUT EJECTED MASS
James W. Hale Arnold Eng. Develop. Center, Jul. 1964 68 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-134; AD-602770)

Data from various diffuser model studies were analyzed to determine the influence of pertinent parameters on ejector–diffuser performance with and without ejected mass from the test cell. The parameters varied with conical nozzle area ratio (3.15 to 18.00), diffuser shape (straight or with various types of bends), mass ejected from the test cell (from 0.11% to 1.31% of rocket flow) for different nozzle configurations (single-, two-, and four-nozzle cluster) and diffuser sizes (4.026- to 10.02-in. diam), and ratio of diffuser-to-nozzle exit area on start and breakdown diffuser pressure ratio with respect to second-throat contraction ratio. Author

N64-26190 Air Force Systems Command, Wright-Patterson AFB., Ohio Foreign Technology Div.
DESIGN OF AIRCRAFT GAS-TURBINE ENGINES
A. V. Shtoda, S. P. Aleshchenko, A. Ya. Ivanov, V. S. Krasavtsev, and F. N. Morozov et al 4 Jun. 1964 579 p refs
Transl. into ENGLISH from the book "Konstruktsiya Aviatsionnykh Gazoturbinnykh Dvigateley" Moscow, Voyennoye Izd. Min. Oborony Soyuza SSR, 1961 p 3–411
(FTD-TT-63-405/1+2; AD-602634)

The fundamental problems in designing aircraft gas turbine engines and approaches to solution of the problems are presented. The material is written at a secondary-school educational level for those people familiar with basic motor theory. Subjects covered include compressors, gas turbines, main combustion chambers and afterburners, exhaust systems, stress-bearing systems and transmission elements, rotor bearings and lubrication systems, propeller hubs and reduction gears, fuel-supply systems, automatic control systems, and starting systems. D.E.W.

N64-26201 Value Engineering Co., Alexandria, Va.
RESEARCH AND DEVELOPMENT OF EROSION AND OXIDATION RESISTANT COATINGS FOR GRAPHITE First Quarterly Report, 13 Mar.–12 Jun. 1964
E. Goodman, R. Thompson, and T. Hogland 13 Jul. 1964 25 p
(Contract N600(19)-61804)
(Rept.-5-RD-64; AD-602363)

Attempts were made to increase the ceramic content of the electrodeposited chromium-base cermet coating previously developed. Many plating variables, such as current density, solution temperature, plating solution composition and flashing time and current density, were investigated. The use of a dispersing agent and the effect of different concentrations of ceramic in the plating solution on the amount of ceramic occluded in the coating were studied. Increasing the ceramic concentration to 0.133 ml/ml of plating solution resulted in a coating containing 5% ceramic. Author

N64-26254* United Aircraft Corp., East Hartford, Conn. Research Labs.
APPLICATIONS OF SNAP-50 CLASS POWERPLANTS TO SELECTED UNMANNED ELECTRIC PROPULSION MISSIONS
W. R. Fimple and T. N. Edelbaum N.Y., AIAA [1964] 15 p refs Presented at the First AIAA Ann. Meeting, Washington, D.C., 29 Jun.–2 Jul. 1964
(Contract NASw-737)
(AIAA Paper-64-494) AIAA: $0.50 members, $1.00 nonmembers

The results of analyses of a number of selected unmanned scientific and logistic space missions are presented. These missions include solar, Jupiter, and Saturn probes, a Venus satellite, and a continuous lunar logistic supply operation. For each mission the potential of electric propulsion (ion rockets powered by the SNAP-50 space nuclear power generating system) is evaluated and compared to the potential of solid-core nuclear-rocket propulsion. The comparisons are made on the basis of performance i.e., payload vs mission time, for the interplanetary missions and on the bases of both performance and cost for the lunar supply operation. The performance results of electric propulsion for the interplanetary missions are presented in plots containing contours of constant power conversion efficiency (i.e., input electric power/thrust power) and constant specific impulse. These plots may be used with reasonable accuracy to evaluate the performance of any thruster with a known variation of efficiency with specific impulse. The use of specific launch vehicles such as the Saturn IB and Saturn V is considered in the analysis. For the economic analysis of lunar supply operations, launching costs as well as estimates of the space vehicle costs are included. In this analysis a learning curve for manufacturing costs is employed. Author

N64-26330 Bristol Siddeley Engines, Ltd. (Gt. Brit.)
AN INVESTIGATION OF REAL GAS EFFECTS RELEVANT TO THE PERFORMANCE OF A KEROSENE FUELLED HYPERSONIC RAMJET
R. Hawkins and M. D. Fox *In* AGARD Supersonic Flow, Chem. Processes and Radiative Transfer 1964 p 113–136 refs
(See N64-26326 18-11) Pergamon: £9

The magnitude of real gas effects in the combustion chamber and exhaust nozzle of a kerosene-fueled engine are examined in detail. The flight speed range of interest is Mach 3·5 to about 8, so that the study was confined to a subsonic combustion cycle. The most important underlying assumptions are, firstly, that the combustion products are homogeneous and in chemical and thermodynamic equilibrium prior to expansion; secondly, that the expansion process is isentropic with sudden freezing of the chemical composition occurring at various specified thermodynamic states. The effect of freezing on several directly measurable parameters is presented with the object of highlighting the most promising experimental methods for investigating the recombination problem. The major objectives for any experimental studies would probably fall into one of two groups; those associated with checking the theoretical predictions of the freezing points for the various chemical species, and the influence of freezing on the flow parameters—particularly the stream thrust, and

those associated with the determination of the thrust coefficient for a particular engine nozzle geometry. Possible techniques for examining both aspects of the recombination problem are presented and discussed. Author

N64-26347 Observatorium Bosscha, Bandung (Indonesia)
THEORETICAL CONSTANT MASS-CHANGE AND THRUST ROCKET [BEBERAPA TJATATATAN MENGENAI ROKET]
K. Purbosiswojo Repr. from Proc. of the Bandung Inst. of Tech. (Indonesia), v. 3, no. 1, 1964 p 11–15 refs In INDONESIAN; ENGLISH summary

In this paper, some equations for idealized rockets are discussed. This type of rocket includes those in which the rate of mass change is constant and those in which thrust is constant in any kind of condition of static pressure and altitude. Author

N64-26403* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EVALUATION AND ANALYSIS OF THRUST UNITS FOR POWER-LIMITED PROPULSION SYSTEMS
R. D. Shelton, R. A. Potter, L. Lacy, and E. Stuhlinger Repr. from AIAA Journal, v. 2, no. 4, 1964 p 682–685 refs Presented at Am. Rocket Soc. Electric Propulsion Conf., Berkeley, Calif., Mar. 14–16, 1962
(NASA-RP-241)

Performance parameters of power-limited propulsion systems are expressed formally in terms of the kinematic properties of thrust units. Ion engine deficiencies, such as neutral efflux, multiple ionization, and propellant stream divergence, are described as velocity distributions in the exhaust stream and are related algebraically to the important mission parameters. The relative importance of these deficiences is therefore determined in the framework of the mission. The discussion provides a background for the selection of the best set of physical measurements to be made for the evaluation of thrust units and shows how these measurements are related to the mission parameters. IAA

N64-26451* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF TEMPERATURE ON NOISE OF BYPASS JETS AS MEASURED IN THE LANGLEY NOISE RESEARCH FACILITY
George T. Kantarges and Jimmy M. Cawthorn Washington, NASA, Aug. 1964 45 p refs OTS: $1.25
(NASA-TN-D-2378)

An investigation of noise from concentric bypass jets was conducted with 2-in. diam subsonic primary-jet nozzles having two different wall thicknesses and was operated at a constant exit pressure corresponding to Mach 0.95 in still air. Three secondary nozzles of different diameters were used and operated at several different subsonic pressure ratios. Retracted, coplanar, and extended positions of the secondary nozzle relative to the primary nozzle were investigated. Primary-jet stagnation temperatures of 70° F and 1,500° F were obtained while the secondary air remained unheated. The maximum sound-pressure levels were measured at the 30° azimuth position for most cases tested. There was a tendency for the maximum sound-pressure level to shift toward the 45° azimuth position for the highest area ratios. Sound spectra of the primary jet alone peaked broadly within a range from 1,000 to 4,000 cps. The spectra of the bypass jet are similar in shape to those of the primary jet alone, with the exception that there is a trend toward lower levels at the higher frequencies. The results of the noise studies suggest that the addition of unheated secondary air to an unheated primary jet usually causes an increase in the noise power, whereas the addition of unheated secondary air to a heated primary jet for bypass ratios up to 8.0 results in no appreciable increase in the noise power. In general, the noise power results for the thinwalled primary nozzle showed less variation than similar results for the thickwalled primary nozzle; thus, much less sensitivity to relative location of the secondary exit is indicated. Author

N64-26453* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
EXPERIMENTAL INVESTIGATION OF HEAVY-MOLECULE PROPELLANTS IN AN ELECTRON-BOMBARDMENT THRUSTOR
David C. Byers, William R. Kerslake, and Jack Grobman Washington, NASA Aug. 1964 40 p refs
(NASA-TN-D-2401)

An experimental program was undertaken to determine the performance of several heavy molecular compounds in a 10-cm-diam electron-bombardment ion thrustor. The effects of various thrustor parametric changes on the overall performance of a particular heavy molecular compound were also investigated. The experimental results indicated that heavy-molecule ion beams could not be produced in quantity, at acceptable levels of thrustor efficiency, from an electron-bombardment thrustor of a design presently used with monatomic propellants. The study of the performance of several test molecular propellants suggested that thrustor discharge phenomena were more important in determining the average mass of the ions in the exhaust beam than were molecular composition and structural characteristics. Variation of a number of thrustor parameters in an attempt to reduce molecular fragmentation produced no significant improvement in overall thrustor performance. Author

N64-26578* Electro-Optical Systems, Inc., Pasadena, Calif.
DESIGN STUDY OF A SOLAR HYDROGEN PROPULSION AND POWER SYSTEM Final Report, 17 May–16 Nov. 1963
F. Mc Farlane, B. Kalensher, B. Wilner, and E. Findl 23 Jul. 1963 133 p
(Contract NAS7-231)
(NASA-CR-58181; EOS-4000-Final) OTS: $10.50 ph

The objective of this program was to perform a study of a combined solar hydrogen propulsion and electric power system for space applications. The study included a performance analysis of the components that comprise the system (a hydrogen storage and feed system, a solar collector and orientation system, a cavity beat-exchanger and thermal regeneration system, thermionic diodes; and rocket nozzles); a design analysis of the combined cavity-absorber; a preliminary design for a 24-hour satellite system; and mission studies to define performance characteristics for comparative propulsion systems (electric and chemical) for a solar probe and several earth-orbit-transfer cases. In general, the analysis supports the feasibility of the solar hydrogen rocket-solar energy thermionic system concept and defines the design constraints imposed on the system when utilizing a combined solar cavity-absorber for both propulsion and power generation. I.v.L.

N64-26579* United Aircraft Corp., Windsor Locks, Conn. Hamilton Standard Div.
AN ENGINEERING STUDY AND PRELIMINARY DESIGN OF A ONE MAN PROPULSION DEVICE FOR LUNAR AND FREE-SPACE ENVIRONMENTS Final Report

James E. Smith et al 21 May 1964 354 p refs
(Contract NAS9-2065)
(PDB-6414)

A study was made of the problems of one-man propulsion in conjunction with presently known as well as contemplated future space missions. The need for one-man propulsion devices in the missions was ascertained, and the desired characteristics of such devices were defined. Five basic systems concepts were found to warrant further study: (1) a large "flying platform" for lunar surface use; (2) a "dual-purpose" unit (for both free-space and lunar-surface use); (3) a portable unit, optimized for the lunar-surface activities associated with the Lunar Excursion Module (LEM); (4) a portable unit, optimized for the Apollo free-space activities; and (5) a simple, hand-held unit for use in free space as an auxiliary to a larger system. As a result of the studies, it was determined that one-man locomotion systems (using rocket propulsion) are not only feasible, but are highly desirable in the manned space missions. P.V.E.

N64-26583* Marquardt Corp., Van Nuys, Calif.
MAGNETOGASDYNAMIC ROCKET FOR SPACE PROPULSION
A. R. Asam and R. J. Sunderland 20 May 1964 93 p refs
(Contract NAS3-2514)
(NASA-CR-54040; MR-25118) OTS: $8.60 ph

A linear crossed field plasma accelerator and test facility was developed. Thrust measurements performed with the accelerator at gas flow rates of 0.1 grms/sec of argon were inaccurate and nonreproducible because of erosion of the accelerator electrode insulators. Severe material erosion limited continuous operation of the accelerator at magnetic fields above 500 gauss to a few minutes. Hall deflection was successfully reduced by staggering the accelerator electrodes. Author

N64-26660 Stanford U., Calif.
A STRATIFIED CHARGE TWO-STROKE SPARK IGNITION ENGINE (RAM STRATICHARGE, VEE-4, 108.6 IN^3 DISP.) PERFORMANCE CHARACTERISTICS
H. E. Fandrich 1 Feb. 1964 98 p refs
(Contract Nonr-225(23))
(TR-S-1; AD-439681)

The operating characteristics of a unique, stratified-charge V-4 two-stroke engine, designed with many manually adjustable controls for the evaluation of the system, are reported. The part-load specific fuel consumption and hydrocarbon emisssions are emphasized. The stratified-charge engine concept has the potential for good part-load economy and low exhaust hydrocarbon emission, since combustion occurs in excess air. R.T.K.

N64-26662 British Internal Combustion Engine Research Assn., Slough (Gt. Brit.)
INVESTIGATION OF THE EFFECT OF COMPRESSION TEMPERATURE ON COMBUSTION IN A DIESEL ENGINE USING AN ATKINSON CYCLE. PART I: TESTS ON A TANGYE VCP1 ENGINE Status Technical Report No. 1, Nov. 1961–Aug. 1963
D. W. Tryhorn 27 Nov. 1963 18 p refs
(Contract DA-91-591-EUC-1540/1794/2657)
(VR-4174; AD-437523)

A Tangye VCP1 engine was tested under high-pressure, variable temperature charge conditions using both early and late inlet valve closing points to reduce the effective compression ratio. It was thus possible to obtain performance data over a range of compression temperatures lower than is feasible with a normal cycle. The results serve to show the effect of compression temperature on an engine with a high swirl, single-hole nozzle, combustion system. The theoretical gains expected from use of the modified Atkinson cycle were, however, not substantiated by the results. This was traced to the excessive values of the charge heating effects associated with the throttling losses that inevitably result from closing the inlet valve while the piston is in mid-stroke. The consequence was that the compression temperature was never low enough to have a really marked effect on combustion, but, at the lowest temperature reached, there was some deterioration in performance attributable to an over-cool charge. Author

N64-26680 Rocketdyne, Canoga Park, Calif.
SELF-COOLED ROCKET NOZZLES Quarterly Progress Report, 1 Nov. 1963–31 Jan. 1964
P. Schwarzkopf and J. D. Seader 27 Feb. 1964 32 p ref
(Contract AF 33(657)-9166)
(R-3853-5; AD-439421)

The advance of the self-cooled rocket nozzle concept is reported. Modifications to the computer-programed theoretical analysis of self-cooling are described. A major addition to the analysis is the calculation of cases for composites of the heterogeneous matrix porosity that indicate the manner by which the self-cooling concept may be optimized. Fabrication procedures for the production of composites of complex matrix microstructure are described. Author

N64-26742 Canadian Armament Research and Development Establishment, Valcartier Defense Research Board
ASPECTS OF REPRODUCIBILITY FOR THE 9KS11000 ROCKET ENGINE
A. G. Herron Feb. 1964 25 p refs
(CARDE-TN-1543164)

The performance data obtained from static firings of the heavy weight and the initial flight weight 9KS11000 rocket engines showed a relatively large amount of scatter. The procedures of manufacture, static testing, and data reduction were examined in detail. Closer control of specific operations is recommended in an attempt to reduce the scatter in overall engine performance. Author

N64-26801 Texaco Experiment Inc., Richmond, Va.
THE AIR TURBO-EXCHANGER ENGINE
8 Mar. 1963 14 p
(MF-180) (Declassified)

A flow diagram is presented of the air turboexchanger engine, and its cycle characteristics are presented. Included are graphs that give the following information related to the exchanger: (1) typical trajectory and pressure recovery requirements for fixed capture area operation; (2) variation of engine thrust-to-weight ratio and specific impulse with flight Mach number as a function of maximum Mach number capability; (3) effect of inlet pressure recovery on air turboexchanger pressure and temperature limits, net thrust, impulse, and inlet capture area; and (4) combustor characteristics and nozzle requirements. R.T.K.

N64-26813 Air Force Systems Command, Wright-Patterson AFB, Ohio AF Aero-Propulsion Lab.
FLUID MECHANICS AND TANKAGE DESIGN FOR LOW GRAVITY ENVIRONMENTS Technical Documentary Report, Jun. 1961–Apr. 1963
Robert G. Clodfelter Sep. 1963 59 p refs
(ASD-TDR-63-506; AD-423554)

Electric propulsion systems for space vehicles must be able to restart and operate at zero and low gravity. This operation can be achieved if the tankage delivers only single-phase propellants. The requirements for feed systems of electric engines are described briefly. Also, the 1.85-second drop-test facility is described, and the testing techniques are discussed. The minimum energy principle is presented along with a method for determining the direction of mass transfer in tapered tubes and liquid-vapor interface shapes in an annular space between concentric cylinders. Possible feed systems for electric engines are given, which utilize surface tension for fluid positioning and transfer. Zero-gravity and static-fluid configurations in cylindrical and spherical containers are discussed along with experimental observations. The interface overshoot of the equilibrium zero-gravity configuration is also disucussed. Author

28 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. *For related information see*: 05 Astronomy and Astrophysics; 16 Life Sciences; and 29 Space Sciences.

N64-25926* National Aeronautics and Space Administration, Washington, D.C.
COSMIC RAYS [KOSMICHESKIYE LUCHI]
S. N. Vernov and L. I. Dorman, ed. Jul. 1964 298 p refs Transl. into ENGLISH from IGY Program, Section VII, no. 3, Moscow, Izd. Akad. Nauk SSSR, 1961
(NASA-TT-F-126) OTS: $4.00

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N64-25927* National Aeronautics and Space Administration, Washington, D.C.
RECENT CONCEPTS OF THE VARIATIONS OF COSMIC RAYS
L. I. Dorman *In its* Cosmic Rays Jul. 1964 p 2–80 refs (See N64-25926 18-28) OTS: $4.00

This review article discusses the development of experimental techniques for studying cosmic rays, such as by a high-latitude network of riometers, crossed counter telescopes, and cosmic rockets. The refinement of analytical techniques for studying cosmic rays and the nature of the temporal variations of cosmic rays are also included. R.T.K.

N64-25928* National Aeronautics and Space Administration, Washington, D.C.
INVESTIGATION OF THE TEMPORAL VARIATIONS OF THE DIFFERENT COMPONENTS OF COSMIC RAYS IN RELATION TO OBSERVATIONS MADE AT A SINGLE POINT
A. I. Kuz'min, N. N. Yefimov, D. D. Krasil'nikov, G. V. Skripin, V. D. Sokolov et al *In its* Cosmic Rays Jul. 1964 p 81–101 refs (See N64-25926 18-28) OTS: $4.00

Examples are given of variations of cosmic rays that are registered by apparatus sensitive to different parts of the energy spectrum and those that are located at the same point. These examples indicate the possibilities of analyzing the nature of such variations and the electromagnetic properties of the environs of the solar system and the galaxy, as well as certain indirect data on elementary particle interactions. R.T.K.

N64-25933* National Aeronautics and Space Administration, Washington, D.C.

INVESTIGATION OF THE VARIATIONS OF COSMIC RAYS AT ALTITUDES OF 9–12 KILOMETERS

L. T. Baradzey, Yu. I. Logachev, and P. P. Shishkov *In its* Cosmic Rays Jul. 1964 p 180–186 refs (See N64-25926 18-28) OTS: $4.00

In order to obtain continuous records of the intensities of the different components of the cosmic radiation, at altitudes of 9 to 12 km, from aircraft, an apparatus for measuring cosmic-ray intensity was designed. The deviations of the total, penetrating, and neutron radiation at 9 and 12 km as obtained in each flight from the mean intensities for all the flights are presented in tabular form. Information is also presented on radiation intensity after a magnetic storm, and on its relation to altitude. R.T.K.

N64-25934* National Aeronautics and Space Administration, Washington, D.C.

SOME RESULTS OF STRATOSPHERIC INVESTIGATIONS OF THE INTENSITY OF COSMIC RAYS AT YAKUTSK

Yu. G. Shafer and V. D. Sokolov *In its* Cosmic Rays Jul. 1964 p 187–193 refs (See N64-25926 18-28) OTS: $4.00

In accordance with the IGY program, regular measurements of stratospheric cosmic-ray intensity were carried out at Yakutsk in 1958 and 1959. A twofold-coincidence counter telescope with a corresponding radio circuit was used as the recording apparatus and sent aloft in sounding balloons. The results of a preliminary analysis of variations of cosmic-ray intensity that is due to large and very large magnetic storms of sudden commencement, the "day–night" effect, and the effect of the season of the year are presented. R.T.K.

N64-25935* National Aeronautics and Space Administration, Washington, D.C.

ON METHODS OF INTRODUCING METEOROLOGICAL CORRECTIONS INTO COSMIC-RAY INTENSITY DATA

Ye. S. Glokova, L. I. Dorman, and N. S. Kaminer *In its* Cosmic Rays Jul. 1964 p 194–214 refs (See N64-25926 18-28) OTS: $4.00

A method is proposed for determining meteorological corrections for cosmic-ray intensity data. This method takes into account variations of atmospheric origin, the barometric effect, and the temperature effect. This method, which was originally proposed by Dorman, was perfected and carefully verified on the basis of experimental data obtained by the Soviet and worldwide network of cosmic-ray stations. These investigations showed that the improved method proposed in this article, based on an integral method of computing meteorological corrections, may be adopted as standards. R.T.K.

N64-25936* National Aeronautics and Space Administration, Washington, D.C.

THE BAROMETRIC COEFFICIENT OF THE NEUTRON COMPONENT

A. V. Sergeyev and A. A. Luzov *In its* Cosmic Rays Jul. 1964 p 215–219 refs (See N64-25926 18-28) OTS: $4.00

Computations of barometric coefficients (β%/mb) of the neutron component are presented for the summer and fall of 1958, the winter of 1958 and 1959, and the spring of 1959. The barometric coefficient for the neutron component is presented for high, medium, and equatorial latitudes. R.T.K.

N64-25937* National Aeronautics and Space Administration, Washington, D.C.

METEOROLOGICAL COSMIC-RAY EFFECTS BELOW GROUND

Ya. L. Blokh, L. I. Dorman, and M. M. Dubrovin *In its* Cosmic Rays Jul. 1964 p 220–223 refs (See N64-25926 18-28) OTS: $4.00

Meteorological cosmic-ray effects at various depths below ground at Moscow (40 meters water equivalent, observation period July to December 1957 and March 1958) and Yakutsk (60 meters water equivalent, observation period July to December 1957 and March 1958) were investigated. Using data from atmospheric–temperature radio sounding, the temperature corrections for each flight were calculated for various depths. The corrections for each light were averaged for all flights made during a 24-hour period. The relationship between cosmic-ray intensity, pressure at observation level, and the temperature correction is presented. The triple correlation method for each observation point was used to find the partial and total correlation coefficients and regression coefficients. The monthly results of calculations made for Moscow and Yakutsk are given in tabular form. Preliminary analysis shows that during solar maxima it is also important to take into account the primary variations of cosmic rays. R.T.K.

N64-25938* National Aeronautics and Space Administration, Washington, D.C.

EMPIRICAL DETERMINATION OF THE TEMPERATURE EFFECT FOR THE HARD COMPONENT OF COSMIC RAYS OVER HEISS ISLAND

M. I. Tyasto *In its* Cosmic Rays Jul. 1964 p 224–229 refs (See N64-25926 18-28) OTS: $4.00

An empirical determination of the variations of the hard component of cosmic rays over Heiss Island (1958) due to changes in atmospheric temperature is made. The intensity of the hard component of cosmic rays at Heiss Island, registered by a cubical telescope and empirically corrected for the temperature effect, was found to reflect, with an adequate degree of accuracy, the variations of the primary flux, whereas correction by L. I. Dorman's method for a given station and instrument did not completely eliminate the temperature effect. R.T.K.

N64-25939* National Aeronautics and Space Administration, Washington, D.C.

CALCULATION OF THE INTEGRAL MULTIPLICITY OF μ-MESON PRODUCTION IN THE EARTH'S ATMOSPHERE FOR OBSERVATION UNDER DIFFERENT THICKNESSES OF ABSORBER

L. I. Dorman *In its* Cosmic Rays Jul. 1964 p 230–264 refs (See N64-25926 18-28) OTS: $4.00

The following are dicussed: (1) ionization losses and decay of μ-mesons; (2) the role of the π-mesons; (3) approximate calculation of integral multiplicity, disregarding fluctuations in the production level, and assuming that the energy is equally distributed among the μ-mesons produced. (4) effect of the spectrum of π-meson production in the elementary event, of the spectrum of their decay into μ-mesons, and of the "spread" of the production level; (5) intensity of μ-mesons, produced in the k^{th} collision, as a function of the atmospheric depth h; (6) intensity of μ-mesons, formed from π-mesons produced in the k^{th} collision, as a function of the atmospheric depth; (7) computation of the number of μ-mesons, reaching the observation level with the energy $\epsilon\mu_0$ and produced by a primary particle with the energy E_0 for the simplest model of the elementary event; (8) calculation of the expected μ-meson energy spectrum at sea level and the

expected variation in the intensity of cosmic rays below ground; (9) calculation of the expected variation in the spectrum and intensity of the μ-mesons with solar activity; (10) calculation of the expected latitude effect for the μ-meson component at sea level; and (11) calculation of the integral multiplicity of μ-meson production for various thicknesses of absorber. R.T.K.

N64-25940* National Aeronautics and Space Administration, Washington, D.C.

COUPLING COEFFICIENTS FOR THE PRIMARY AND SECONDARY VARIATIONS OF COSMIC RAYS IN THE HIGH ENERGY REGION

L. I. Dorman *In its* Cosmic Rays Jul. 1964 p 265–272 refs (See N64-25926 18-28) OTS: $4.00

Research into the variations of cosmic rays demonstrates the important problem of the determination of coupling coefficients in the region of energies higher than the cutoff rigidity at the Equator. This is especially important in relation to the conversion of secondary variations of the intensity of μ mesons at sea level and at different depths below ground to primary variations at the top of the atmosphere. By using the results of calculations of the integral multiplicity of μ-meson production N (E_0, Δ ϵ) for different thicknesses of absorber the coupling coefficients for observations of μ-meson intensity at sea level, and as different depths below ground are calculated. R.T.K.

N64-25941* National Aeronautics and Space Administration, Washington, D.C.

EFFECT OF CHANGES IN SOLAR ACTIVITY ON THE COUPLING COEFFICIENTS BETWEEN PRIMARY AND SECONDARY VARIATIONS OF COSMIC RAYS. SOME PRACTICAL PROBLEMS REGARDING THE DETERMINATION OF THE SPECTRUM OF THE VARIATIONS

L. I. Dorman *In its* Cosmic Rays Jul. 1964 p 273–279 refs (See N64-25926 18-28) OTS: $4.00

Information is presented on the variation in coupling coefficients for the different components of cosmic rays with variation in solar activity: (1) above the top of the atmosphere, for the neutron components at a height of 10 km, at mountain altitudes, and at sea level; and (2) for the total ionizing components at a height of 10 km (pressure about 300 mb) and 4.3 km, and for the hard component at sea level (registration with a shielded counter telescope and a shielded ionization chamber). R.T.K.

N64-25942* National Aeronautics and Space Administration, Washington, D.C.

THE METEOROLOGICAL EFFECTS IN RELATION TO THE FREQUENCY OF EXTENSIVE AIR SHOWERS NEAR SEA LEVEL

D. D. Krasil'nikov *In its* Cosmic Rays Jul. 1964 p 280–285 refs (See N64-25926 18-28) OTS: $4.00

A new method is presented of introducing geometric corrections in the analysis of barometric effects in relation to the frequency of extensive air showers near sea level. The results of an evaluation of the barometric coefficient, based on extensive observational material, are given. Included is a graph of the barometric coefficient as a function of the number of particles in a shower. R.T.K.

N64-25943* National Aeronautics and Space Administration, Washington, D.C.

ON THE ORIGIN OF LARGE IONIZATION BURSTS OBSERVED UNDER DENSE MATERIALS NEAR SEA LEVEL

D. D. Krasil'nikov *In its* Cosmic Rays Jul. 1964 p 286–291 refs (See N64-25926 18-28) OTS: $4.00

The results of an evaluation of the contribution of μ-meson showers to the observed burst frequency near sea level are given. This estimate is based upon a detailed examination of transition effects, and it yields conclusions as to the spin and magnetic moment of the μ-meson. R.T.K.

N64-25944* National Aeronautics and Space Administration, Washington, D.C.

ON THE PROBLEM OF THE TEMPORAL DISTRIBUTION OF EXTENSIVE AIR SHOWERS OF COSMIC RAYS

N. N. Yefimov *In its* Cosmic Rays Jul. 1964 p 292–294 (See N64-25926 18-28) OTS: $4.00

A large installation for the continuous registration of extensive air showers of cosmic rays was developed, and data were obtained on the intensity of up to 1,500 showers per hour. The time distribution of extensive air showers for small time intervals was investigated. In particular, the applicability of Poisson's law for time intervals up to 1 sec was studied. R.T.K.

N64-26079* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

VERY HIGH-ENERGY COSMIC RAYS

C. E. Fichtel Repr. from Phys. Review Letters, v. 11, no. 4, 15 Aug. 1964 p 172–173 refs

(NASA-RP-260)

A model for explaining some of the features of cosmic radiation is discussed. To summarize the basic ideas of this model, the cosmic-ray particles, after being accelerated in the supernovae, travel along a spiral arm until they reach the end of the arm segment, and then enter into the galactic halo. Because of the finite size of the spiral-arm segment and the strength of the field therein, there must be an upper limit to the rigidity of a particle that can be easily held in such a segment. Since in terms of the cosmic-ray power-law spectrum of total energy, protons, helium nuclei, and heavy nuclei are known to have nearly the same relative abundance above a given total energy at lower energies, $< 10^{13}$ev, the transition occurring at about 10^{16}ev rigidity corresponds to a very marked transition in particle composition at about 10^{16} to 10^{17}ev total energy, if the source composition distributions continue to hold at energies above 10^{13}ev. In addition, a possible heavy anisotropy relative to the spiral-arm segment at these energies can be explained. Another and probably more significant change in the differential energy spectrum is expected at about 10^{19}ev total energy. I.v.l.

N64-26085 Joint Publications Research Service, Washington, D.C.

INVESTIGATION OF COSMIC RAY INTENSITY FLUCTUATIONS IN THE STRATOSPHERE CAUSED BY SOLAR PROCESSES

A. N. Charakhch'yan 29 Jul. 1964 43 p refs Transl. into ENGLISH from Uspekhi Fiz. Nauk (Moscow), v. 83, no. 1, 1964 p 35–62

(JPRS-25641; TT-64-31913) OTS: $2.00

Conclusions reached as a result of investigating cosmic-ray intensity fluctuations in the stratosphere caused by solar processes include the following: (1) The phenomenon of

cosmic-ray bursts in the stratosphere is due to the generation of cosmic rays on the sun at the time of chromospheric flares. (2) Cosmic ray bursts in the stratosphere correlate with a number of geophysical phenomena—absorption of galactic radio emission in the polar-cap regions, geomagnetic storms, ionospheric disturbances, decreases in the intensity of galactic cosmic rays, and Forbush decreases. (3) The energy spectra of protons generated in flares do not change with time. (4) There are two sharply differing forms of the energy spectrum of the protons of flares—the first obtained before the beginning of the corresponding geomagnetic storm and the second obtained during it. P.V.E.

N64-26178 Milan U. (Italy) Inst. of Physical Sciences
MEASUREMENT OF THE COSMIC RAY NEUTRON FLUX AT 45° GEOMAGNETIC LATITUDE
G. Boella, G. Degli Antoni, C. Dilworth, M. Panetti, and L. Scarsi 11 May 1964 34 p refs
(Grant AF-EOAR-63-106)
(AFCRL-64-487; AD-602653)

In a series of balloon flights with a lightweight neutron detector, the flux of the cosmic-ray neutrons in the atmosphere, at 45° geomagnetic latitude, was investigated. The energy spectrum proposed by Newkirk agreed with the experimental results. Values of the neutron flux through the atmosphere are given, and by extrapolation to zero pressure, the neutron leakage was determined as (0.45 ± 0.07) neutron/cm^2 sec. at the top of the atmosphere. A detailed study of the previous experiments on albedo neutrons that led to conflicting results was made and showed that the apparent discrepancies can be accounted for by instrumental bias and locally produced neutrons. Author

N64-26407* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE ZENITHAL DISTRIBUTION OF EXTREMELY-HIGH-ENERGY COSMIC-RAY MUONS IN THE ATMOSPHERE
Kaichi Maeda Repr. from J. of Geophys. Res., v. 69, no. 9, 1 May 1964 p 1725–1736 refs
(NASA-RP-270)

The approximate calculation of intensities of high-energy cosmic-ray mu-mesons at sea level given by Smith and Duller is improved by a rigorous calculation for larger zenith angles and higher energies, starting from the integral formula instead of the diffusion equation of cosmic-ray mu-mesons in the atmosphere. Similar computations are done to show the contribution of kaons; the results are compared with those of Zatseptin and Kuzmin, who used a different attenuation mean free path. The largest difference between the contributions of pi-mesons and kaons appears for mu-meson energies of 100 to 1,000 gev, as Zatseptin and Kuzmin pointed out. Measurements of obliquely incident high-energy mu-mesons are helpful in determining the energy dependence of the attenuation mean free path of charged mu-mesons in the atmosphere rather than to distinguish the mu-meson parent particles. To resolve the arguments regarding the additional source of high-energy cosmic-ray mu-mesons, it is proposed that these observations be extended to mountain altitudes. IAA

N64-26488 Yale U., New Haven, Conn.
SEARCH FOR PLANETARY OPTICAL EMISSION, AND STUDY OF FLARE ACTIVITY OF NEARBY STARS Final Report
Harlan J. Smith 20 May 1964 6 p refs
(Grant Nonr(G)-00014-63)
(ONR-14-63; AD-600154)

A summary of program accomplishments includes these: (1) the construction of an effective 20-inch reflecting telescope at the Yale Observatory Bethany Station; (2) the construction of a unique dual-channel pulse-counting photoelectric spectrophotometer, more sensitive than the best previously employed spectrophotometer, by about three orders of magnitude, for variations lasting several seconds or longer; (the new instrument is especially effective for a New England climate by being able to work without loss of accuracy through haze and thin clouds); (3) testing of certain modern photomultipliers and the detection of hitherto unreported effects as to their behavior, (4) the demonstration that Jovian H-alpha auroras are absent, to unexpectedly low levels, and that the search for Jovian auroras should now probably be carried out using other possible lines or bands; and (5) preliminary indications that strong H-alpha flares are not of great frequency in late *K* dwarfs. I.v.L.

N64-26509 General Dynamics/Astronautics, San Diego, Calif. Space Science Lab.
HIGH RESOLUTION STUDIES OF TYPE III SOLAR EMISSION AT 11.4m WAVELENGTH
W. C. Erickson [1962] 25 p refs
(Contract AF 49(638)-561)
(ERR-RN-233)

Enhanced solar radio emission was observed during May and June, 1962, at a wavelength of 11.4m (26.3 mc/sec) by the Clark Lake Antenna. Two emission regions were observed. They were of large angular size (about 2 to 3 solar radii in diameter), they fluctuated rapidly in amplitude (periods about 4 seconds of less), and they appeared to rotate with the sun and to have been located at distances of about 2.0 and 2.5 solar radii from the sun's center. Correlation with swept-frequency data indicates that most or all of the observed emission was of spectral type III. On the basis of these data, plasma levels corresponding to densities of 8.5×10^6 electrons/cm^3 are estimated to have been at heights of 2.0 and 2.5 solar radii over the active regions. These estimates agree well with the coronal streamer model of Newkirk. The average brightness distribution of one of the emission regions was consistent with the core and halo model proposed by Weiss and Sheridan. Author

N64-26602 Argentina Comision Nacional de Energia Atomica, Buenos Aires
ENHANCEMENT OF THE X-RAY INTENSITY AT BALLOON ALTITUDES IN THE SOUTH AMERICAN ANOMALY
H. S. Ghielmetti, N. Becerra (Univ. Nacl. Cordoba), A. H. Godel (Univ. Naci. Cordobal), H. Heredia, and J. D. Roederer (Buenos Aires U.) [1964] 8 p refs
(Sponsored by CNICT and the Ford Found.)

A series of balloon experiments was carried out between December 7 and 13, 1963, over the Atlantic Ocean, about 900 miles east of Buenos Aires. Three flights carried X-ray equipment. Details of these flights are summarized in tabular form. The existence of an additional flux of low-energy X-rays in the region of the South American Anomaly, detectable above 30 km, was found. It is believed that this X-ray flux enhancement originates in electron bremsstrahlung. R.T.K.

N64-26713* Consultants and Designers, Inc., Arlington, Va.
SUGGESTION ABOUT THE NATURE OF LUMINOUS PARTICLES OBSERVED BY ASTRONAUTS [PREDPOLZHENIY O PRIRODE SVETYASHCHIKHSYA CHASTITS, NABLYUDAVSHIKHSYA KOSMONAVTAMI]
A. I. Lazarev 24 Jun. 1964 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Geofiz. (Moscow), v. 156, no. 2, 11 May 1964 p 306–307
(Contract NAS5-2078)
(NASA-TT-F-8916; ST-OA-IM-10162)

It is assumed that the luminous particles, observed by astronauts, when entering the earth's shadow, are probably incandescent micrometeorites at their collision with the spacecraft's surface, or possibly particles of that surface, torn out by collision. This article considers the radiation of a heated particle formed at collision. Equations for the following are presented: (1) the particle's heat balance; (2) the light force of the particle's visible radiation; (3) the illumination at the astronaut's pupil; and (4) the value of the threshold illumination. Particle temperature as a function of diameter, and illumination created by a particle in the astronaut's pupil as a function of time after collison are given. It is indicated that particles of a 1μ diameter will be practically unobservable; those of a 10μ diameter, moving with an angular velocity of 10^4 deg/sec^{-1}, will be practically visible. Particles with a 50μ diameter, moving with angular velocities of 10^5 deg/sec^{-1} will be well visible during tens of milliseconds; at angular velocities of 10^6 deg/sec^{-1}, particles of a 50μ diameter will be visible during 4 to 5 milliseconds. I.v.L.

N64-26717 Chicago U., Ill. Enrico Fermi Inst. for Nuclear Studies
RESEARCH ON THE SOLAR-GEOPHYSICAL ASPECTS OF COSMIC RADIATION AND MAGNETO-HYDRODYNAMICS Final Technical Report, 18 Dec. 1954–30 Nov. 1962
J. A. Simpson 3 Sep. 1963 51 p
(Contracts AF 19(604)-4554; AF 19(604)-1288)
(AFCRL-63-893; AD-437872)

Some 60 papers were published during the seven-year period covered by this final report. Most of these papers resulted from the work of the two staff members, E. N. Parker and J. A. Simpson. These papers covered both theoretical and experimental researches concerned with the properties of the interplanetary medium including magnetic fields and plasma density, the solar production of high-energy particles and their propagation through the interplanetary medium, and selected topics on the properties of the geomagnetic field (geomagnetic storms, particle motions in the geomagnetic field, etc.). Included in this report is a list of publications, as well as abstracts of their contents. Also attached is a listing of the scientific and engineering staff who contributed to the work. Author

N64-26769* Consultants and Designers, Inc., Arlington, Va.
CONCENTRATION TO THE ECLIPTIC OF NIGHT SKY EMMISSION IN THE LINE H α AND ITS RADIAL VELOCITIES [O KONTSETRATSII IZLUCHENIYA NOCHNOGO NEBA V LINII H α K EKLIPTIKE I O LUCHEVYKH SKOROSTYAKH ETOY LINII]
P. V. Shcheglov 29 Jun. 1964 13 p refs Transl. into ENGLISH from Astronom. Zh. (Moscow), v. 41, no. 2, 1964 p 371–377
(Contract NAS5-2078)
(NASA-TT-F-8919; ST-AA-10165)

New observations of the nightglow emission in H_α are described in this paper. Its strong concentration to the sun and to the ecliptic is observed. These observations fit the model of a cloud in the ecliptic plane, with an increasing density at night and decreasing in daytime. The interaction of emission and absorption lines in the course of such observations is discussed. Author

N64-26786* Consultants and Designers, Inc., Arlington, Va.
THE ABSOLUTE MEASUREMENT OF THE ENERGY EMITTED BY THE CENTER OF THE SUN'S DISK BETWEEN 4600 AND 8600 A
M. Roger Peyturaux 22 Jul. 1964 4 p Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), no. 4, 27 Jan. 1964 p 1159–1160
(Contract NAS5-3760)
(NASA-TT-F-8929; ST-SP-10178)

This report is concerned with observations made during the summers of 1961, 1962, and 1963, (using a specially constructed blackbody as the reference source) for 13 wavelengths selected between 4,477 A and 8,638 A. All wavelengths were measured at different epochs and by slightly different methods. Curves are plotted, showing the average points in the standard (ergs/s/cm^2/sterad/$\Delta\lambda$ + 1 cm) and showing $1/\lambda$ plotted as the abscissa and log 17 (0.0) $-\log B\lambda$ as the ordinate, $B\lambda$ being the energy of the blackbody at 7,000°K. The existence of two depressions was observed; one was toward 4,800 A, and the other was toward 5,000 A. The first can be interpreted by the existence of very large wings for the line H_β (4,861 A). There seems to be no possible interpretation for the second depression. I.v.L.

N64-26807* California U., San Diego
THEORIES OF THE ORIGIN OF RADIO SOURCES
E. M. Burbidge and G. R. Burbidge [1963] 21 p refs Presented at the Symp. on Gravitational Collapse and other Topics in Relativistic Astrophys., Dallas, Dec. 1963
(Grant NsG-357)
(NASA-CR-58133) OTS: $2.60 ph

This article covers the following areas: (1) violent events in galaxies—relation between strong radio sources, quasi-stellar radio sources, and Seyfert galaxies; (2) possible sources of energy for radio galaxies; and (3) theoretical requirements for a successful theory of radio sources. R.T.K.

N64-26812 Oslo U., Blindern (Norway) Inst. of Theoretical Astrophysics
SECULAR VARIATIONS IN SHORT-LIVED SUNSPOTS Scientific Report No. 16(38)
Truls S. Ringnes Repr. From Astrophys. Norvegica (Oslo), v. 3, no. 2, 1962 p 17–52 refs
(Contract AF 61(052)-186)
(AFCRL-63-770; AD-423925)

Secular variations, distinct from the 11-year period, are found in number, distribution of area, and other features of sunspots with lifetimes of about one day. The variations are connected with the secular changes in the relation between magnetic field strength and area of sunspots. Author

N64-26822 Lockheed Missiles and Space Co., Sunnyvale, Calif.
COSMIC RADIATION: AN ANNOTATED BIBLIOGRAPHY, 1960–1963
Peter R. Stromer and Helen B. Mc Cormick, comp. May 1963 77 p refs
(Contract AF 04(647)-787)
(SB-63-71; Rept.-3-56-63-4; AD-443485)

This bibliography contains a comprehensive selection of reference material on the title subject with emphasis on the near earth space environment as differentiated from interplanetary space. Period of coverage is from 1960 to early 1963. Author

N64-26831 Air Force Cambridge Research Labs., Bedford, Mass.
CELESTIAL BACKGROUND RADIATION. I: A REVISED SCALE OF BOLOMETRIC CORRECTIONS Air Force Surveys in Geophysics No. 155(1)
Russell G. Walker Mar. 1964 100 p refs
(AFCRL-64-169(1); AD-206616)

A short review is given of the literature pertinent to the bolometric correction. A recommended scale of bolometric corrections is presented based upon recent model atmospheres for stars of early spectral type, and upon stellar energy distributions synthesized from photoelectric observations of stars later than FO V. The reduction of various photoelectrically determined magnitude and color systems to a common system and the further reduction of these measurements to absolute energy units are discussed in some detail. Author

29 SPACE SCIENCES

Includes space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories. *For space biology see*: 16 Life Sciences. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance.

N64-25850 France Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux
MOTION OF ARTIFICIAL SATELLITES. DETERMINATION BASED ON THE EXACT SOLUTIONS OF THE PROBLEM OF THE TWO FIXED CENTERS [MOUVEMENT DES SATELLITES ARTIFICIELS. CALCUL A PARTIR DES SOLUTIONS EXACTES DU PROBLEME DES DEUX CENTRES FIXES]
Christian Marchal May 1964 87 p In FRENCH; ENGLISH summary
(ONERA-TN-111)

The gravity potential of the earth is first assimilated to that established by two imaginary attracting points; then the equations of motion of a satellite within this potential are integrated. The results obtained are then corrected by an amount corresponding to the difference between the mathematical model and the real earth potential. Then the perturbations caused by other celestial bodies are determined. The effects of other perturbations are also discussed. Author

N64-25887 Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
SYMMETRIC DOUBLY-ASYMPTOTIC ORBITS IN THE RESTRICTED THREE BODY PROBLEM
Andre Deprit and Jacques Henrard Apr. 1964 33 p refs
(DI-82-0337; AD-439215)

This study concerns special orbits of the plane-restricted three-body problem—symmetric orbits that are doubly asymptotic orbits to one of the three collinear equilibrium points and that are generated in a particular way. Also presented are more accurate series to calculate the abscissas of these equilibrium points and third-order approximations of the merely exponential solutions around these configurations. Numerical interpolation produced 35 special values of the mass ratio that gives rise to doubly asymptotic orbits—3 for the L_1 point, 2 for the L_2 point, and 30 for the L_3 point. Two of these values are of particular interest since they are near the mass ratio of the earth–moon system. Author

N64-25888 RAND Corp., Santa Monica, Calif.
STRANGE SOUNDS FROM THE SKY
Mary F. Romig and Donald L. Lamar Apr. 1964 8 p refs
(P-2894; AD-439336)

Anomalous sounds associated with fireball passage are discussed. These sounds, which have been described as hissing, swishing, whizzing, whirring, buzzing, and crackling noises, have been heard simultaneously both with seeing the light and before seeing the light. There is little evidence to indicate that these sounds are physically real; but if they are real, they must certainly be the result of an electromagnetic process. If some of the radiation from fireballs were deposited in the far infrared or radiofrequency regime, a possible explanation for the sounds might emerge from recent experiments on electrophonic hearing conducted by A. H. Frey. Frey found that some human subjects, whose audible hearing by air or bone conduction was good above 5,000 cps, when exposed to beams of low-power radar sets, perceived sensations of sound described as buzzing, clicking, hissing, or knocking, depending on the transmitter parameters. Care was taken to exclude possible rectification of the pulse-modulated signal. A peak electromagnetic power density as low as 400 w/cm^2 could be perceived as sound. Perhaps the electromagnetic waves act directly on the brain. I.v.L.

N64-25914* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPROXIMATE SOLUTIONS FOR FLIGHT-PATH ANGLE OF A REENTRY VEHICLE IN THE UPPER ATMOSPHERE
Jack A. White and Katherine G. Johnson Washington, NASA, Jul. 1964 44 p refs
(NASA-TN-D-2379) OTS: $1.25

Two basic equations for approximating the flight-path angle of a reentry vehicle in the upper atmosphere are derived from the equations of motion. These solutions for flight-path angle are obtained (1) by assuming constant velocity over the portion of the trajectory under consideration, and (2) by approximating the velocity value for use in the development of the equation for flight-path angle. Solutions obtained from numerical integration of the nonlinear reentry equations are used to evaluate how well the derived equations approximate the true value of flight-path angle. Author

N64-25917 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
LOW THRUST OSCILLATORY ASCENDING SPIRAL TRAJECTORIES AS AFFECTED BY AIR DRAG
Chong-Hung Zee Dec. 1963 21 p refs
(ADN-06-06-63.3)

The ascending spiral trajectory of a satellite subject to air drag and a low constant tangential thrust is derived by the asymptotic method in nonlinear mechanics. Based on the assumption of an exponential distribution of atmospheric density, closed-form solutions for the first-order approximation are obtained. The oscillatory nature of the spiral trajectory is exposed, and the oscillations are shown to damp out as the satellite spirals out. Author

N64-25972* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
DETERMINATION OF CRATERING ENERGY DENSITIES FOR METAL TARGETS BY MEANS OF REFLECTIVITY MEASUREMENTS
Herman Mark, Gary Goldberg, Michael J. Mirtich Repr. from AIAA Journal, v. 2, no. 5 [1964] p 965–966 refs
(NASA-RP-240)

A brief review of an experimental and theoretical investigation to determine the damage to surface optical properties of satellites or satellite components due to impact with high-speed micron-size particles is given. Polished aluminum surfaces were bombarded by clouds of high-speed SiC particles having an average diameter of 6μ. The number, size and velocity of the particles were either known or measured. The total kinetic energy of the cloud characterized the exposure, and thus changes in reflectivity of the exposed surfaces could be measured with an IR spectrometer. Equations developed for calculating values of cratering energy density are presented, and the calculated values are compared tabularly to those determined experimentally. IAA

N64-25973* National Aeronautics and Space Administration. Goddard Space Flight Center Greenbelt, Md.
COHENITE AS A PRESSURE INDICATOR IN IRON METEORITES
Michael E. Lipschutz and Edward Anders (Chicago U.) Repr. from Geochim. Cosmochim. Acta, v. 28, 1964 p 699–711 refs
(Contract AT(11-1)-382; Grant NSF-G-14298)
(NASA-RP-246)

To evaluate the usefulness of cohenite as a pressure indicator in iron meteorites, the thermodynamics and kinetics of its decomposition were reexamined. Laboratory experiments on the decomposition of Fe_3C at high pressures failed to show stabilization, and it was therefore necessary to revise the high-pressure portion of the Fe–C diagram. The stability field of Fe_3C becomes greatly constructed, and the stabilization of cohenite by high pressures no longer seems feasible. If iron meteorites had cooled slowly at pressures of 30 to 60 kb, cohenite should have decomposed in a matter of hours to graphite or diamond, at temperatures below 640° to 565° C. The times actually available for decomposition were longer by factors of 10^{10} to ^{11}, and the survival of cohenite therefore seems to require the assumption that nucleation was inhibited by a factor of this order. If the iron meteorites had originated at low pressures, precisely the same assumption (nucleation inhibited by a factor of 10^{10} to 10^{11}) must be made. Hence there is no longer any reason to attribute the survival of cohenite to high pressures. Laboratory experiments show that the decomposition of cementite at 680° C and 1 atm can indeed be inhibited by factors $> 10^5$. Meteoritic cohenite, having a much higher degree of crystal perfection, should be inhibited in its decomposition to an even greater extent. IAA

N64-25974* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.
THE CONTRIBUTION OF ABSORPTION LINES TO THE OPACITY OF MATTER IN STELLAR INTERIORS
Albert Arking and Jackson Herring Repr. from Publ. Astron. Soc. Pacific, v. 75, no. 444, Jun. 1963 p 226–235 refs
(NASA-RP-254)

A calculation of the contribution of the absorption lines to the opacity of stellar material at conditions typical of stellar interiors (temperatures of 1 to 20 × 10^6° K and electron densities of ~ 3 × 10^{25}/cm^3) is reported. The results indicate that the total Rosseland mean opacity is increased by ~ 10% to 40% above the continuous opacity for the Keller and Meyerott Group X mixture of elements. The mass fractions of this mixture are hydrogen (0.485), helium (0.485), and heavier elements (0.03); of the heavier elements the most important, at the temperatures under consideration, are iron, potassium, and aluminum. Their mass fractions are included. R.T.K.

N64-26071* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SOLAR COLLECTOR DEVELOPMENT
Atwood R. Heath, Jr. and Preston T. Maxwell (NASA, Washington, D.C.) Repr. from Astronautics and Aerospace Eng., May 1963 p 58–61 refs
(NASA-RP-223)

Several concepts of solar collectors that are suggested for use in space are discussed. The advantages and disadvantages of the various collectors are indicated, and diagrams showing comparisons of parameters (efficiency, unit weight, etc.) of the collectors are presented. P.V.E.

N64-26164 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ROCKETS IN ORBIT
B. Trofimov 27 May 1964 8 p Transl. into ENGLISH from Krasnaya Zvezda (Moscow), 15 Apr. 1964 p 1
(FTD-TT-64-536/1+4; AD-602340)

As was noted in the foreign press, rocket weapons must include a large number of 3-ton satellites as the last rocket stages. These must move around the earth in circular orbits. It is believed that such an orbital rocket system must assure attack of previously selected objectives 20 minutes after reception of the radio command. It was also noted that in addition to the warhead, each orbital rocket must have aboard a braking motor, a system for orientation, automatic guidance control, electrical power sources, as well as means of technical control. Foreign specialists believe that due to the complexity of orbital rockets, their operational reliability will be significantly lower than that of ICBMs of the ground-to-ground class. However, under conditions of antimissile defense, orbital weapons are less vulnerable. The present state-of-the-art of rocket technology makes it possible to place orbital rockets at the necessary altitude. The problem in this case is the securing of the accuracy in guiding the orbital rocket to the target. The duration of flight of an orbital rocket can be measured in hours or even days, depending on the initial velocity. According to a predetermined program, they may deviate from their normal trajectory and may be used at any time to deliver a strike to the target. I.v.L.

N64-26200 Aerospace Corp., El Segundo, Calif. Guidance and Control Subdivision
ECLIPSE FRACTIONS FOR SUN-SYNCHRONOUS ORBITS
H. K. Karrenberg 10 Jun. 1964 93 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-100; TDR-269(4550-10)-10; AD-603152)

Eclipse fraction is defined as the fraction of the orbital period that a satellite spends in the earth's shadow. This fraction is of great importance to any satellite that depends on a solar cell for its electrical power. Sun-synchronous orbits possess unusual eclipsing properties because of the unique orbital characteristic defining them. The purpose of this study is to determine the characteristics of noneclipsed sun-synchronous orbits (providing they exist) and the time history and average value of the eclipse fraction for those orbits that are eclipsed. Comparisons with nonsolar synchronous orbits

are made. The effects of atmospheric drag, lunar and solar gravitational fields, injection errors, oblate earth geometry, atmospheric refraction of the sun's rays, and the eccentricity of the earth's orbit are examined. Comparisons with the investigations of other authors are made. Author

N64-26229 Aerospace Corp., El Segundo, Calif. Electronics Div.

OPTIMUM GUIDED ASCENT

Frank M. Perkins 25 Jun. 1964 33 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-120; TDR-269(4540-70)-4; AD-602651)

Presented in this paper are simple approximate closed-form equations for the thrust attitude pitch program to minimize propellant consumption for any spacecraft or missile ascending in a vacuum. A small amount of aerodynamic force, such as frequently occurs in the early part of guided flight, should not invalidate these equations. Also presented are explicit guidance equations for the optimum pitch program, which were developed specifically for the case of constant thrust and propellant flow rate. Since the form of the optimum pitch angle-versus-time equation is independent of the variation of thrust acceleration with time, continuous application of this program is permitted through more than one propulsion stage to achieve maximum performance. Author

N64-26250 Joint Publications Research Service, Washington, D.C.

FIVE YEARS OF SOVIET SPACE RESEARCH

M. B. Kroshkin and V. G. Samarin 3 Aug. 1964 29 p refs
Transl. into ENGLISH from Geofizicheskiy Byul., no. 13, Moscow, 1963 p 80–93
(JPRS-25-705; TT-64-31977) OTS: $2.00

This review presents brief references of the basic stages of cosmic research, which were completed in the Soviet Union during the years 1957–1962. Data are cited about all Soviet cosmic apparatus launched from 1957 to 1962. Author

N64-26310* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

MARTIAN AIRGLOW

Edward C. Y. Inn Repr. from J. Atmospheric Sci., v. 21, no. 2, Mar. 1964 p 220–221 refs
(NASA-RP-250)

A mechanism of blue Martian airglow, which can be expected to occur on Mars as well as on Venus, is discussed. It is assumed that the Martian atmosphere is composed of 2% CO_2 and the remainder is N_2, the surface pressure being about 100 mb. The density disbribution of these constituents, with altitude, should be somewhat similar to that of the Earth. Thus, at some altitude corresponding to unit optical depth for solar radiation short of 1700A where CO_2 absorbs, the following photodissociation process can be expected: $CO_2 + h\nu \rightarrow CO + O$. If it is assumed that some sort of photochemical equilibrium exists at these altitudes, then one of the important reactions that follows the photodissociation is $CO + O + M \rightarrow CO_2 + M$, where M refers to any other atom or molecule, principally, however, to N_2. This is in essence a chemiluminescent recombination reaction with a characteristic complex banded spectrum due to CO_2 between about 5,000A to 3,000A, the maximum intensity being at about 4,000A. Although there appears to be some question as to the kinetics and mechanism of this recombination, it is clear that the emission is due to electronically excited CO_2. I.v.L.

N64-26364* California U., Los Angeles Inst. of Geophysics and Planetary Physics

[ESTABLISHMENT OF A SPACE PHYSICS LABORATORY TO DEVELOP INSTRUMENTATION FOR SPACE RESEARCH] Semi-annual Report

Thomas A. Farley 1 Apr. 1963 12 p refs
(Grant NsG-249-62)
(NASA-CR-58043) OTS: $1.60 ph

The current program status includes the following: (1) A substantial effort in the analysis of data from the magnetometer aboard Mariner II was undertaken. The earlier portion of this effort involved the detection and correction of errors introduced into the data by the data-reduction program or by other steps in the process of identifying, tabulating, and plotting the telemetered data. More recent work has been the determination of corrections for the temperature variations of the magnetometer and of other pertinent subsystems. (2) Slow (CsI scintillator) pulse detector, fast (plastic scintillator) pulse detector, and analog storage and readout electronic circuits were devised for use in the Ranger Program. I.v.L.

N64-26369* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

SPACE PROGRAMS SUMMARY NO. 37–27, VOLUME IV, FOR THE PERIOD APRIL 1, 1964 TO MAY 31, 1964 SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT

30 Jun. 1964 244 p refs
(Contract NAS7-100)
(NASA-CR-58131) OTS: $16.00 ph

The current status of the following areas is discussed: (1) trajectory systems analysis; (2) guidance and control; (3) engineering mechanics (materials studies and applied mechanics); (4) solid, liquid, and MHD propulsion; (5) space sciences; and (6) telecommunications. An intense magnetic-field facility that is nearing completion is described. I.v.L.

N64-26370* Aerojet-General Corp., Azusa, Calif. Production Projects Div.

ENGINE OPERATING PROBLEMS IN SPACE. VOLUME I: THE SPACE ENVIRONMENT Final Report, 15 Feb. 1962–14 Mar. 1964

W. W. Howard and U. A. Coty Apr. 1964 223 p refs
(Contract NAS7-98)
(NASA-CR-58136; Rept.-2824; Vol. 1) OTS: $15.00 ph

This volume presents a comprehensive definition of the space environment as it is presently known. For the purposes of this program, this environment consists of the solar system, excluding the earth and its inner atmosphere. Special emphasis is given to data on electromagnetic and particulate radiation, meteoroid flux, and the structure and composition of the planetary atmospheres. A list of 405 references is included; many of these are annotated. Author

N64-26373* Stanford U., Calif.

INVESTIGATION OF OPTIMAL CONTROL WITH A MINIMUM-FUEL CONSUMPTION CRITERION FOR A FOURTH-ORDER PLANT WITH TWO CONTROL INPUTS; SYNTHESIS OF AN EFFICIENT SUB-OPTIMAL CONTROL

A. J. Craig and I. Flugge-Lotz [1964] 15 p refs Presented at the Joint Autom. Control Conf., Stanford, Jun. 1964
(Grant NsG-133-61)
(NASA-CR-58124) OTS: $1.60 ph

Application of Pontryagin's optimal principle to control system problems eventually requires that a two-point boundary value problem be solved. For plants whose equations of motion are greater than second order this represents a formidable

barrier in realizing a practical feedback control. When the criterion for optimization is minimum fuel consumption, choice of time for solution may be used as a free parameter, and this, plus consideration of the efficiency of application of control, leads to an approximate method that avoids this difficulty. A heuristic analysis of the geometry of state-space trajectories, using true optimal solutions as a guide, provides laws for constructing a feedback control from the state variables. It further provides a knowledge of the bounds of performance of the mechanized suboptimal control and an estimate on the performance of a minimum time control for comparison purposes. As an example, the method is applied to the problem of minimum-fuel attitude control—a fourth-order plant with two controls—of an earth-orbiting satellite. Author

N64-26404* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMMENTS ON EXHAUST FLOW FIELD AND SURFACE IMPINGEMENT
Leonard Roberts and Jerry C. South, Jr. Repr. from AIAA Journal, v. 2, no. 5, May 1964 p 971–973 refs
(NASA-RP-242)

The problem of the impingement of a jet exhaust on simulated lunar surfaces is considered and is discussed both theoretically and experimentally. Included is information on the region of applicability of present theory for conical nozzles, the variation of surface pressure with height, and the surface pressure distribution. R.T.K.

N64-26597* IIT Research Inst., Chicago, Ill. Astro Sciences Center
SUMMARY OF FLIGHT MISSIONS TO JUPITER Digest Report
1 Jul. 1964 29 p
(Contract NASr-65(06))
(NASA-CR-58120; M-4) OTS: $2.40 ph

The feasibility of an unmanned scientific mission to Jupiter to obtain astrophysical information concerning the planet and its environment was studied. The report deals primarily with an overall assessment of the problem areas that must be considered in successfully completing a Jovian mission, as well as attempts to establish the feasibility of achieving such a mission using present state-of-the-art vehicle technology, and the scientific payload. The results of the study indicate that a useful scientific mission to Jupiter is feasible with presently available chemical propulsion techniques, sensors, power supplies, telemetry links, and boosters. The development of a high-performance final-stage rocket compatible with the vehicles considered was found to be desirable for either a flyby or orbiter mission. R.T.K.

N64-26787* Consultants and Designers, Inc., Arlington, Va.
METHODS FOR DETERMINING THE THREE COMPONENTS OF THE MAGNETIC FIELD IN THE SUNSPOTS
Jean Rayrole 28 Jul. 1964 5 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), no. 4, 27 Jan. 1964 p 1161–1162
(NASA-TT-F-8932; ST-SP-10180)

To determine the three components of the magnetic field vector in the sunspots, new methods were conceived and partially applied. Instead of analyzing the profile of the normal triplet for the different polarizations, several favorable Zeeman decomposition lines were studied, a single parameter being measured on each. Author

N64-26866* Massachusetts Inst. of Tech., Cambridge, Mass. Experimental Astronomy Lab.
INTERPLANETARY MIDCOURSE GUIDANCE ANALYSIS, VOLUME I
Robert Gottlieb Stern, (Ph.D. Thesis) 10 May 1963 222 p refs (Contracts NAS9-153; AF 04(647)-303; Grant NsG-254-62) (NASA-CR-51827) OTS: $15.00 ph

This thesis deals with the midcourse guidance correction of the path of an interplanetary vehicle by means of several intermittent thrust impulses. The analysis is linearized by assuming that the vehicle's actual path differs only from a known precomputed reference path. The difference between these two paths is known as the variant path. The linearized equations of motion are those in which the dependent variables are the position and velocity components of the variant path. Emphasis is placed on the analytic solution of the linearized equations of motion. Two distinct methods are developed for this solution when the reference trajectory is an ellipse. The first method involves the separation of the sixth-order system into two independent systems:—one of the fourth order and the other of the second order. Although the two independent systems have variable coefficients, both are integrated in closed form. The second method utilizes variational techniques to determine the effect on the path of small variations in a set of six orbital elements. The two solutions are shown to be mathematically equivalent. The analytic solution is used to obtain closed-form expressions for the elements of all the matrices appearing in the guidance system. A midcourse guidance system is outlined that utilizes the analytic results of this theoretical investigation. I.v.L.

N64-26926* National Aeronautics and Space Administration. Washington, D.C.
NASA TO BEGIN UNMANNED MARS EXPLORATION THIS YEAR (A FACT SHEET) News Release No. 64–205
21 Aug. 1964 5 p Available from the Scientific and Technical Information Division

NASA will launch two Mariner space vehicles in the fourth quarter of this year. The Mariner Mars spacecraft will weigh about 570 pounds. They will have a span of 22 feet, with panels extended, and a height of 9 1/2 feet. Flight times vary, relative to the day of launch, from 7 1/2 months to 8 1/2 months, with an additional 3 weeks of flight needed to return from beyond the planet. An Atlas-D/Agena-D combination will be used to launch the Mariners. Unprecedented distances in space are involved in this mission. At launch, the Mariners will be aimed along a 350 million-mile-long path between the orbits of Earth and Mars. At the time the spacecraft comes closest to Mars, the planet and the Earth will be about 150 million miles apart. This mission will use the following technical advantages for the first time: (1) high-frequency radio communication; (2) a midcourse guidance rocket engine that can be fired twice; (3) first use of the Agena-D second stage and first use of the Atlas-D with many improvements; and (4) first use of the star Canopus for spacecraft attitude reference. Scientific equipment of the Mariners will report on radiation, magnetic fields, and micrometeorites in interplanetary space. I.v.L.

N64-26929* Consultants and Designers, Inc., Arlington, Va.
OPTIMUM COPLANAR FLIGHT BETWEEN ORBITS, TAKING INTO ACCOUNT THE INNER RESERVE MASS PROPORTIONAL TO FLIGHT TIME [KOMPLANARNYY OPTIMAL'NYY POLET MEZHDU ORBITAMI S UCHETOM VNUTRENNEGO ZAPASA MASSY, PROPOTSIONAL'NOGO VREMENI POLETA]

S. N. Kirpichnikov 23 Jul. 1964 18 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Astron. (Leningrad), no. 7, 1964 p 116–128
(Contract NAS5-2078)
(NASA-TT-F-8928; ST-CM-10176)

The case of two material bodies such as rockets, satellites, space probes, etc., moving between assigned orbits with the aid of a single boost is considered. All the orbits are assumed to be coplanar and Keplerian, and motion takes place along a single direction on all orbits. The mass of the bodies is assumed to be variable and is proportional to the total flight time. The total mass of the system takes into account the masses of the orientation engines, chemical batteries, accumulators, radio transmitters, and the like. Flights between orbits of small eccentricities, circular orbits, and other special cases are investigated. Where flight time is neglected as one of the parameters, more optimal trajectories are obtained. The flights of sounding rocket probes to planets of the solar system, and the problem of hitting a satellite moving along a well known orbit from a body moving in another known orbit are examples of this type of orbital maneuver. E.W.

30 SPACE VEHICLES

Includes launch vehicle-spacecraft combinations; missile systems; operating problems; safety devices; and stability and control. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-25962 Picatinny Arsenal, Dover, N.J.
PARAMETRIC STUDIES ON USE OF BOOSTED ARTILLERY PROJECTILES FOR HIGH ALTITUDE RESEARCH PROBES, PROJECT HARP
S. Wasserman, G. Lattal, and J. Smolnik Jan. 1964 148 p refs
(TR-3147; AD-601409)

A general parametric and preliminary design study defining the potential capabilities of rocket-boosted artillery projectiles (BAP's) for high-altitude research probes (HARP) is presented. The study covers BAP's fired from the 5-, 7-, and 16.4-in. guns and compares the dispersion of a typical BAP with a free rocket. Data are presented showing that BAP's afford a relatively inexpensive method of accomplishing a variety of high-altitude missions with significantly greater accuracy than free rockets, and even offer the potential for orbiting small payloads. Author

N64-26108 Aerospace Corp., El Segundo, Calif. Lab. Operations
SATELLITE INFRARED BACKGROUND EXPERIMENT DATA ANALYSIS
H. W. Wessely 15 Jun. 1964 41 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-101; TDR-269(4710-29)-1; AD-602762)

The results of a statistical analysis of background data obtained with a satellite borne radiometer operating in the 1.4, 1.8, 2.2, and 2.7 μ spectral regions are presented. The insolation angle is considered as a fundamental parameter of the background, and all statistical distributions are accordingly referred to a specific insolation angle. Distributions of the absolute radiance and local radiance difference are presented. Joint probability amplitude distributions together with the derived linear correlation coefficients for certain spectral band pairs are also presented. Author

N64-26171 Radio Corp. of America, Burlington, Mass. Aerospace Systems Div.
ADAPTION FOR SPACE VEHICLES THROUGH ON-BOARD DIGITAL COMPUTER CONTROL
A. S. Bachman, K. T. Klarman, and C. F. Matthews Wright-Patterson AFB, Ohio, AF Avionics Lab., Apr. 1964 222 p refs
(Contract AF 04(695)-279)
(AL-TDR-64-62; AD-602608)

Space mission effectiveness can be increased by providing vehicles with the ability to adapt to equipment failures and to unexpected events. The characteristic of adaptiveness can be incorporated into a vehicle through proper organization of data/command flow combined with preplanning of responses to abnormal situations. The study has verified that these functions can be implemented in an onboard digital computer-controller. Concepts and terminology, system organization, methodology, and measures of effectiveness were developed and applied to two model missions. Evaluation of a well-defined rendezvous spacecraft clearly indicates that substantial increases in mission success may be obtained through computer controlled adaptation. A second analysis applies the same system organization to a complex manned vehicle of the 1970's in order to define a useful upper limit to control computer requirements. The major conclusion of the study is that the implementation of adaptation is feasible, effective, and practical. Recommendations are made for actions leading to immediate implementation of these techniques and for further conceptual study, improve the power and generality of the control technology. Author

N64-26253* Lockheed Missiles and Space Co., Sunnyvale, Calif. Research and Development Div.
ANALYSIS OF FLOW SEPARATION EFFECTS ON THE DYNAMICS OF A LARGE SPACE BOOSTER
Lars-Eric Ericsson and J. Peter Reding N.Y., AIAA [1964] 21 p refs Presented at the first AIAA Ann. Meeting, Washington, D.C. 29 Jun.–2 Jul. 1964
(Contract NAS8-5338)
(AIAA Paper-64-482) AIAA: $0.50 members, $1.00 nonmembers

It was shown that by using quasi-steady theory and experimental static data the aerodynamic damping of a vehicle that is dominated by separated flow can be successfully computed. The damping so computed has been shown to be in good agreement with experimental data in the transonic speed range. While the supersonic damping has not been substantiated quantitively, because of the lack of experimental dynamic data, there appears to be substantial qualitative evidence supporting the predicted trends. Results of the quasi-steady analysis of the Saturn I-Apollo vehicle, which revealed important dynamic characteristics of flow separation, are presented. N.E.A.

N64-26305* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PROSPECTS FOR OBTAINING AERODYNAMIC HEATING RESULTS FROM ANALYSIS OF METEOR FLIGHT DATA
H. Julian Allen and Nataline A. James Washington, NASA, Jul. 1964 123 p refs
(NASA-TN-D-2069) OTS: $2.75

Analyses of velocity and luminosity records of meteor flight obtained from ground-based cameras provide a means for increasing knowledge on aerodynamic heating of bodies entering the atmosphere at earth hyperbolic speeds. The principles of the dynamical and photometrical methods of analysis are reviewed. Results from records of six bright meteors are compared with expected behavior for these meteors. Reasons for departure from expected behavior are discussed and future prospects are treated. Author

N64-26355* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
RANGER BLOCK III LAUNCH CONSTRAINTS PLANNING DOCUMENT
John S. Reuyl 26 Jul. 1963 98 p refs
(Contract NAS7-100)
(NASA-CR-56667; EPD-130) OTS: $8.60 ph

This document delineates the requirements placed by and the capability of each of the four systems that constitute the Ranger Block III Project. These are the spacecraft and launch-vehicle systems, the Space Flight Operations Facility, and the Deep Space Instrumentation Facility. In addition, the requirements and capabilities of the Atlantic Missile Range are described. Appendixes are presented concerning Ranger trajectories, requirements for tracking and telemetry, tracking and telemetry coverage capability, all the launch constraints that exist, and the effect of these constraints on the design of the Launch Operation Plan. I.v.L.

31 SPACE VEHICLES (LAUNCH VEHICLES)

Includes boosters; clustered rockets; and multistage rockets. *For propulsion engines see*: 27 Propulsion. *For manned space capsules, satellites, and sounding rockets and space probes see*: 32 Space Vehicles (Spacecraft). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-25894* National Aeronautics and Space Administration, Washington, D.C.
LAUNCH VEHICLE TECHNOLOGY
George E. Mueller N.Y., AIAA, [1964] 24 p Presented at the 1st AIAA Ann. Meeting, Washington, D.C., 29 Jun.–2 Jul. 1964 (AIAA Paper-64-527) AIAA: $0.50 members, $1.00 nonmembers

A brief summay of the development and current status of launch vehicle technology is presented. Topics included in the discussion are (1) cost effectiveness; (2) status of development—structures, guidance, engines, and propellants; (3) status of testing; (4) checkout and launch operations; and (5) extending the capability of existing launch vehicles. P.V.E.

N64-26409* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
ANALYSIS OF BOOSTER SYSTEMS WITH A RECOVERABLE HYPERSONIC AIRPLANE FIRST STAGE
Gerald Knip, Jr., and John L. Allen N.Y., AIAA [1964] 9 p refs Presented at the AIAA Aerospace Propulsion Meeting, Cleveland, 4–6 May 1964
(AIAA Paper-64-543) AIAA: $0.50 members, $1.00 nonmembers

An analysis was made of a hydrogen-fueled, turbo-ramjet powered, winged, recoverable HTOL (horizontal takeoff and landing) booster in parallel with one or more lox-hydrogen expendable rocket stages. It was found that a typical takeoff gross weight for a winged air-breathing booster necessary for the mission of orbiting 25,000 lbs is 361,000 lbs. This weight corresponds to a payload fraction of 6.93%. For this orbital payload class, winged air-breathing boosters may offer a solution to reducing operating costs associated with future space programs. R.T.K.

N64-26768* Consultants and Designers, Inc., Arlington, Va.
CONTRIBUTION TO THE THEORY OF STAGE ROCKETS [K TEORII STUPENCHATYKH RAKET]
V. A. Ikosmodem'yanskiy 26 Jun. 1964 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Mechan. (Moscow), v. 156, no. 2, 11 May 1964 p 286–289
(Contract NAS5-2078)
(NASA-TT-F-8917; ST-CM-10163)

This study involves the problem on the optimum selection of a multistage rocket. From the mathematical viewpoint this problem is reduced to the type Boltz–Mayer variational problem. The peculiarity of this kind of problem lies in the fact that the form of guidance functions over variation intervals between discontinuity points is known. The position of the discontinuity points of guidance functions is found from the extreme conditions of a certain functional. The concrete computation is conducted on the example of a two-stage rocket motion in a uniform gravitational field without taking into account the medium's resistance. Author

32 SPACE VEHICLES (SPACECRAFT)

Includes manned space capsules; satellites; and sounding rockets and space probes. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-25874* National Aeronautics and Space Administration, Washington, D.C.
COMMUNICATIONS SATELLITES. A CONTINUING BIBLIOGRAPHY
Jul. 1964 95 p refs
(NASA-SP-7004) OTS: $1.00

An annotated bibliography of reports and documents dealing with the development, operation, and problems of communication satellites is presented. P.V.E.

N64-25893 Air Force Systems Command, Bedford, Mass. Electronic Systems Div.
A SUMMARY OF CONFIGURATION DESIGN STUDIES FOR A RANGE INSTRUMENTATION CALIBRATION SATELLITE
Joseph J. Blum 31 Mar. 1964 68 p refs
(Contracts AF 19(628)-2992; AF 19(628)-3274; AF 19(628)-3235; AF 19(628)-2979; AF 19(628)-3260)
(ESD-TDR-64-255; AD-439358)

This report summarizes the results of five separate but related analytical investigations into the engineering design of a calibration satellite. The suitability and adaptability of the

MISTRAM, GLOTRAC, and AN/DPN-66 C-Band radar transponders, and xenon flash optical beacon, for use in a proposed calibration satellite, are discussed. The overall results of a separate satellite integration study are presented. Design specifications have been developed that allow initiation of transponder development. The detailed preliminary satellite design study has established that an adaptation of the TIROS satellite will fulfill calibration satellite requirements. Author

N64-25932* National Aeronautics and Space Administration, Washington, D.C.
RADIOSONDE FOR MEASURING THE INTENSITY OF THE COSMIC RADIATION IN THE STRATOSPHERE
A. N. Charakhch'yan *In its* Cosmic Rays Jul. 1964 p 177–179
(See N64-25926 18-28) OTS: $4.00

The radiosonde described is intended for very simple measurements of the cosmic radiation in the stratosphere, that is, registration of the intensity of the particles with the aid of a single counter or a telescope consisting of two Geiger counters. The simplicity of operation and low cost of these instruments (cosmic-ray radiosondes) make possible frequent measurements from balloons and systematic records of the level of cosmic-ray intensity in the stratosphere at different points. A circuit diagram and a general view of the instrument are included. R.T.K.

N64-26038* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
GEMINI RENDEZVOUS PROGRAM
James A. Chamberlin and James T. Rose (NASA. Langley Res. Center) Repr. from J. Spacecraft and Rockets, v. 1, no. 1, Jan. 1964 p 13–18 refs Presented at the AIAA-NASA 20 Manned Spaceflight Meeting, Dallas, Tex., 22–24 Apr. 1963
(NASA-RP-239)

One of the main purposes of the Gemini program is to establish techniques for the rendezvous and docking of space vehicles. Since it is expected that these techniques will be used in many other space programs, the Gemini rendezvous experiments have been planned to provide the basic information needed. Provision has been made for accomplishing rendezvous in several ways, each having special features to be explored in the program so that an optimized operational procedure can be established. Author

N64-26181 Bendix Corp., Baltimore, Md. Friez Instrument Div.
DEVELOPMENT OF THE AN/AMQ-21 MULTICHANNEL RADIOSONDE Final Report
S. L. Ashford and W. P. Gleisner Jun. 1964 79 p
(Contract AF 19(628)-2834)
(AFCRL-64-326; AD-602443)

The development of the AN/AMQ-21 continuous transmission multichannel radiosonde for use with Rawin Set AN/GMD-2 for meteorological soundings is described. Primary functions of the radiosonde are the measurement of slant range, temperature, humidity, and the provision for using an index of refraction sensor. It is a balloon-borne ground-launched device, transmitting all data simultaneously on a standard radiosonde carrier frequency. The report includes design considerations, descriptions of the radiosonde electronic system, discussion of associated antenna development, results of environmental and flight tests, and recommendations for additional developmental work. Author

N64-26281 Rome U. (Italy) Centro Ricerche Aerospaziali
SAN MARCO PROJECT—THE FIRST ITALIAN SATELLITE LAUNCHING
1961 132 p refs

A general description is given of the San Marco Project from the point of view of scientific experiments and of the engineering connected with the operation. The main scientific experiment to be carried out in the satellite is the measurement of the local density in the upper layer of the atmosphere in the region between 200 and 300 km. The other experiments to be carried out in the satellite are concerned with the study of the ionosphere in the equatorial region where the magnetic equator coincides with the geodetic equator. The satellite will be launched into an equatorial orbit by a Scout vehicle launched from a mobile base consisting of two floating platforms with movable legs. P.V.E.

N64-26350* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 4, NUMBER 13
15 Jul. 1964 13 p
(NASA-TM-X-51832; X-533-63-1) OTS: $1.60 ph

The following information is presented for objects launched in 1958, 1960, 1961, 1962, 1963, and 1964: code name, catalog number, source, launch date, nodal period, inclination, apogee, perigee, transmitting frequency, and the date of decay (if applicable). R.T.K.

N64-26423 National Aeronautics and Space Administration, Washington, D.C.
SEVENTH RANGER READY FOR LAUNCH ON MOON PHOTO FLIGHT News Release No. 64-176
23 Jul. 1964 59 p Available from the Scientific and Technical Information Division

According to NASA, the seventh Ranger spacecraft, designated Ranger-B, will be launched from Cape Kennedy on a mission to obtain closeup photographs of the moon during the 6-day period beginning July 27. During this time, the moon will be in its third quarter when lighting conditions on desirable target areas are satisfactory. An Atlas-Agena will be the launch vehicle. The primary objective of this mission is to obtain pictures of the moon that will identify features one-tenth as large as are visible with the best earth-based photography. Technical information is also included on the Ranger spacecraft. Previous Ranger missions are described, the Ranger trajectory is also given, and the mission is described. The Deep Space Network is also discussed. R.T.K.

N64-26492 Weather Bureau, Washington, D.C. Meteorological Satellite Lab.
METEOROLOGICAL PRODUCTS FROM DIGITIZED SATELLITE VIDECON CLOUD PICTURES
C. L. Bristor and W. M. Callicott Mar. 1964 41 p refs
(MSL-26; AD-600078)

Procedures are described whereby digitized vidicon cloud photos will be computer processed. Data rates, preprocessing as well as rectification and mapping are discussed, and problem areas are indicated. The kinds of output are described, and products from various display devices are provided through checkout samples. Author

N64-26516* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A SUMMARY REVIEW OF THE SCIENTIFIC FINDINGS OF THE MARINER VENUS MISSION

Charles P. Sonett Repr. from Space Sci. Rev. (Dordrecht), v. 2, 1963 p 751–777 refs Presented in part at the 100th Ann. Meeting of the Natl. Acad. of Sci., Wash., D.C., 22–24 Apr. 1963 (NASA-RP-271)

Descriptive review is presented of the scientific findings of Mariner II, limited to the interplanetary particles and fields measurements and Venus encounter data. The evidence of Pioneer V, concerning an omnipresent magnetic field, is confirmed. Magnetic storms were observed. Bursts of cosmic radiation lasting typically a day were seen by the onboard counter, but whether these were electrons or ions could not be determined. The small particle flux in space lends support to the hypothesis of a dust particle concentration only near the Earth. Due to a malfunction, there were no particle data on the Venus neighborhood. Three planetary scans were made. Experimenters concluded that the scanned area in each case was an unbroken cloud cover with no apparent pattern of convective instability. IAA

N64-26576* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 2, NO. 13
Ralph R. Stroble 31 Jul. 1962 6 p
(NASA-TM-X-51869; X-533-62-55) OTS: $1.10 ph

Tabular data computed and compiled by the Goddard Space Center, NORAD, and The Smithsonian Astrophysical observatory at 1200Z on July 31, 1962, are presented. The data concern objects in orbit that were launched in the years 1958 through 1962. Also, a list of objects that decayed from July 25, 1962, to July 30, 1962, inclusive, is given. I.v.L.

N64-26728 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ASTRONAUTICS Selected Articles
17 Jun. 1964 7 p Transl. into ENGLISH from Astronautyka (Poland), no. 1, 1963 p 27
(FTD-TT-64-86/1+2; AD-442435)

This report on the Soviet cosmic probe Mars I presents information on the equipment situated on board, measurements of the intensity of cosmic radiation, and the photographing of Mars I in flight. J.L.D.

N64-26746 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
THE "ELEKTRON" SPACE SYSTEM [KOSMICHESKAYA SISTEMA "ELEKTRON"]
S. N. Vernov, G. A. Skuridin, and Yu. I. Logachev London, Min. of Aviation, Apr. 1964 14 p Transl. into ENGLISH from Pravda (Moscow), 15 Mar. 1964 Previously Published as JPRS-23810; see N64-17554 09-32
(RAE-TRANS-1062; JPRS-23810)

The satellites Elektrons I and II both launched from the same rocket, were designed to make simultaneous measurements of the radiation zones around the earth. This article describes the purpose of the satellites, explains some of the difficulties that had to be overcome, and gives a brief account of the satellites, instrumentation, and layout. Author

N64-26804* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
ATMOSPHERIC ENVIRONMENT FOR SATURN (SA-5) FLIGHT TEST
J. W. Smith 30 Apr. 1964 41 p refs
(NASA-TM-X-53040) OTS: $4.60 ph

An evaluation of atmospheric conditions during the flight test of Saturn (SA-5) is presented. The general synoptic situation for the flight area is discussed, surface observations are presented, and upper air data, measured near launch time by rawinsonde and rocketsonde observation, are given. Wind and thermodynamic data are presented graphically and compared to the reference atmosphere. Atmospheric effects on the performance of Saturn (SA-5) are listed. Author

N64-26835 Rome U. (Italy) Inst. di Costruzioni Aeronautiche Centro
SAN MARCO SATELLITE EPHEMERIDES — PRELIMINARY DESIGN CALCULATIONS
Paolo Santini, Severino Giorgi, and Fausto Calabria Feb. 1964 26 p refs
(San Marco Proj.)

This report deals with an ephemerides evaluation, with emphasis on perigee ephemerides, of the San Marco satellite for the orbital launching at Wallops Island. A theoretical analysis and calculations were developed with the twofold purpose of predetermining, at least within some degree of approximation, the satellite orbital path and of choosing a number of sites on the earth's surface (particularly in Italy) where it might be convenient to install one or more telemetry and/or tracking ground stations to follow the satellite in its motion. The investigation criterion was that of evaluating ephemerides by analytic relationships to provide satisfactory precision contemporarily collected in a compact set for easy and quick handling. On the basis of the chosen criterion, and taking into account the satellite orbit, it was possible to neglect the orbit perturbations apart from those due to aerodynamic drag and to higher harmonics of the earth's gravitational field. I.v.L.

33 STRESSES AND LOADS

Includes fatigue; vibration; flutter; and structural tests. *For thermal stress see*: 13 Heat Transfer and Thermodynamics. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 34 Structural Design.

N64-25839 Naval Research Lab., Washington, D.C.
THE USE OF ULTRASONIC WAVES FOR STRESS DETERMINATIONS
E. W. Kammer and Irwin Vigness 10 Apr. 1964 28 p refs
(AD-438449)

A method, based on ultrasonic technology, for determining residual or internal stresses in metal structures is discussed. In the suggested method, a gating circuit is devised to examine a selected signal from the receiving transducer after a predetermined time delay, and operates on a portion of this signal by clipping, differentiating, phase sensing, or other suitable shaping function. The output is used to key the pulse generator at the proper instant by adjusting the prevailing pulse-repetition frequency. The portion of the received signal to be analyzed maintains an accurately known time relationship with respect to the pulse repetition-frequency. A detailed description of the system and some of the results obtained are given. P.V.E.

N64-25886 Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.

RUPTURE SURFACES OF THICK SPHERICAL SHELL UNDER PRESSURE

Sadia M. Makky Apr. 1964 27 p refs

(DI-82-0336; AD-439018)

The theory of fracture on surfaces of instability was applied to predict, analytically, the possible surfaces on which a thick-walled spherical shell will rupture. The shell is assumed to be made of an incompressible, rigid–perfectly plastic material satisfying either Tresca or von Mises yield criterion. Furthermore, it is assumed that the internal pressure is sufficient to render the shell material fully in the plastic state. Under these conditions, the spherical shell is subject to rupture on radial planes whose intersections with the inner and outer surfaces of the shell are arcs of great circles. Author

N64-25908* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

FRACTURE TOUGHNESS TESTING

John E. Stanley and William F. Brown, Jr. Washington, NASA 1964 126 p refs

(NASA-TM-X-52030) OTS: $1.00 ph

The subject of fracture–toughness testing is developed in stages, starting with a simple idealized model of a fracture toughness specimen referred to as the quasi-two-dimensional prototype specimen. This allowed the development of the important concepts of crack-extension resistance and fracture instability in essentially two-dimensional terms. Next, complications are considered that are associated with finite thickness and with the change in fracturing behavior and apparent toughness as the thickness is varied through the transition from slant, or plane stress, fracture mode to square, or plane fracture mode. This led to the consideration of the measurement of plane-strain crack toughness (G_{Ic}). Practical specimen types, which require reasonable amounts of material and loading capacity, are considered. The narrow symmetrical types for general G_{Ic} (the value of the strain-energy release rate with crack extension per unit length of crack border) testing, and several specimens suitable for G_{Ic} testing only are discussed. A summary table is provided for comparing the various types of G_{Ic} measurement specimens and test instrumentation, and certain aspects of specimen design and preparation are described. I.v.L.

N64-25955 Martin Co., Baltimore, Md.

OPTIMUM RATE SWITCH SETTING STUDY

D. Kerr and T. Flink Jun. 1964 37 p

(LV-351)

This rate switch optimization study was prompted by the excessive structural loading induced by the loss of a 400-cycle power switchover event. The structural loading for this event exceeds the maximum acceptable 0.93 ultimate level and approaches the ultimate tested strength. Preliminary investigation of the characteristics of this failure mode indicated that the structural loading could be reduced to an acceptable level by reducing the rate switch settings. A reduction of the rate switch settings, however, could not be initiated without first considering the degradation of the inadvertent switchover margin. The analysis of these results shows that the optimum rate switch setting is a compromise between structural loads and inadvertent switchover considerations. R.T.K.

N64-25999 Aeronautical Research Inst. of Sweden, Stockholm

AN EXPERIMENTAL INVESTIGATION OF CREEP BUCKLING OF CIRCULAR CYLINDRICAL SHELLS SUBJECT TO AXIAL COMPRESSION

Ake Samuelson 1964 35 p refs

(FFA-98)

An investigation of creep buckling of cylindrical shells made of Swedish-manufactured 51S–T aluminum alloy was carried out. The radius-to-thickness ratios chosen varied from 32 to 150, and all cylinders were tested at a constant temperature, 225° C, and constant axial compressive stress levels ranging from 8 to 13 kg per mm^2 (11.4 to 18.5 ksi). The dependence of the experimentally obtained lifetime on boundary conditions and geometry of the shell and the properties of the material are discussed in some detail. The deformations of the cylinders due to creep in the prebuckling stage were investigated, and the postbuckling deformations were compared with those obtained in elastic buckling at room temperature. A comparative study of existing theories showed that fairly good agreement could be attained in the case of relatively thick shells, whereas a large disparity would appear in the case of thin shells. Author

N64-26084 Tokyo U. (Japan) Inst. of Industrial Science

INFLUENCE SURFACES OF ORTHOTROPIC PLATE

Tadahiko Kawai Feb. 1964 98 p refs *Its* Report of the Inst. of Ind. Sci., v. 13, no. 6, Serial No. 93

In this paper, the extension of the theory of influence surfaces to orthotropic plates is made, the approach being based on the mathematical concept of Green's Function for the deflection of a plate. Solutions for the moments of semi-infinite strips and of infinite strips, with various boundary conditions, are derived mostly in closed form. Such a solution in closed form will render numerical computations much easier than series solutions as presented by Pucher and other investigators. A general discussion of the singularities of the surfaces are presented with several numerical examples. Approximate methods of solution on influence functions of a plate with complex shape and boundary conditions are discussed briefly. Author

N64-26090 Bureau of Mines, College Park, Md. Applied Physics Lab.

TRIAXIAL METHOD FOR DETERMINING THE ELASTIC CONSTANTS OF STRESS RELIEF CORES

Leonard Obert 1964 26 p refs

(BM-RI-6490)

A triaxial procedure is described for measuring the modulus of elasticity and Poisson's ratio of stress relief cores—the concentric hole cores obtained by the overcoring technique. The elastic constant determinations can be made at stress levels comparable with those encountered in underground mining. The results from tests on an aluminum alloy calibration specimen and four rock specimens are included. Author

N64-26112 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

ON FREE OSCILLATIONS OF A CYLINDRICAL SHELL REINFORCED WITH STIFFENING RIBS

M. I. Karpov 12 Jun. 1964 7 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. SSR (Kiev), no. 8, 1963 p 1018–1021

(FTD-TT-64-72/1; AD-442485)

A method is proposed that accurately satisfies the equations of oscillations of a reinforced shell. Frequency equations are obtained in the form of a transcendental equation. These equations can be used to solve all types of problems involving frequency spectrums. R.T.K.

N64-26183 Aerospace Corp., El Segundo, Calif.
EXPERIMENTAL INVESTIGATION OF THE STABILITY OF INTERNALLY PRESSURIZED CONICAL SHELLS UNDER TORSION
V. I. Weingarten 8 Jun. 1964 56 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-14; TDR-269(4560-40)-1; AD-601985)

From an analysis of the buckling of conical shells under external pressure, torsion, and axial compression, numerical values are obtained of the critical torsional loads of selected internally pressurized conical shells. These values are compared with experimental results. No simple expression for the interaction curve between torsion and internal pressure was found for conical shells. Author

N64-26187 Stanford U., Calif.
BUCKLING OF AXIALLY COMPRESSED CIRCULAR CYLINDRICAL SHELLS AT STRESSES SMALLER THAN THE CLASSICAL CRITICAL VALUE
N. J. Hoff and L. W. Rehfield May 1964 31 p refs
(Contract AF-49(638)-1276)
(AFOSR-64-1037; AD-603153)

Closed-form solutions are given of the linear Donnell equations defining the buckling of thin-walled circular cylindrical shells subjected to uniform axial compression. In addition to the classical simple support conditions requiring the vanishing of the radial displacement, the axial bending moment resultant, the axial additional stress, and the circumferential displacement, three other, equally justifiable, simple support conditions are defined and studied in the case of the semi-infinite shell. Two of them yield buckling stresses amounting to about one-half the classical critical stress. Author

N64-26228 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
ULTRASONIC TECHNIQUES AND STANDARDS FOR TESTING FILAMENT-WOUND STRUCTURES Technical Documentary Report, 1 May 1963–27 Mar. 1964
C. J. Adams, N. H. Radtke, and J. D. Klein Wright-Patterson AFB, Ohio, AF Materials Lab., May 1964 71 p refs
(Contract AF 33(657)-10995)
(ML-TDR-64-117; AD-602277)

Optimum techniques and standards were developed for ultrasonic testing of filament-wound reinforced resin-glass structures. Filament-wound reference test blocks, 0.1-in. to 2.0-in. thick (in 1/4-in. increments), were fabricated. Blocks were prepared of optimum quality and with simulated defects. One set of optimum blocks was adhesively bonded to rubber liners that were 0.080-in. to 3.0-in. thick. Ultrasonic tests were performed to measure acoustic properties and to establish optimum test conditions to detect such defects as delaminations, unbond, porosity, and resin content. Ultrasonic tests were performed by immersed through-transmission methods and by both immersed and contact pulse-echo methods. The optimum method of defect detection was through-transmission testing with facsimile recording. A combination of through-transmission methods and pulse-echo methods was used in evaluating defects detected by through-transmission testing. Pressure vessels obtained from several manufacturers of filament-wound structures were ultrasonically tested by techniques and standards developed in this program. Discontinuities in these chambers were reliably detected. Author

N64-26418* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
STRESS-INTENSITY FACTORS FOR A SINGLE-EDGE-NOTCH TENSION SPECIMEN BY BOUNDARY COLLOCATION OF A STRESS FUNCTION
Bernard Gross, John E. Srawley, and William F. Brown, Jr. Washington, NASA, Aug. 1964 13 p refs
(NASA-TN-D-2395)

A boundary value collocation procedure applied to the Williams stress function was employed to determine the elastic stress distribution in the immediate vicinity of the tip of an edge crack in a finite-width specimen subjected to uniform tensile loading. This type of single-edge-notch specimen is particularly suitable for determination of plane strain fracture toughness values. The analytical results are expressed in such a way that the stress intensity factor may be determined from known conditions of specimen geometry and loading. As the crack length decreased, the results obtained by the collocation procedure approached those derived from a closed solution for an edge crack in a semi-infinite plate. Over a range of ratios of crack length to specimen width between 0.15 and 0.40 the collocation solution yielded results in very good agreement with those derived from experimental compliance measurements. Author

N64-26427 Syracuse U., N.Y. Metallurgical Research Labs.
CRACK INITIATION IN METALLIC MATERIALS Quarterly Progress Report No. 1
V. Weiss, P. Packman, G. Nash, and K. Schroder Apr. 1964 25 p
(Contract NOw-64-0275-d)
(MET-E-1160-0464-QP1; AD-600327)

Experimental investigations on the process of failure in LiF single crystals were continued in order to obtain a deeper insight into the dislocation mechanism responsible for crack initiation. It was found that the surface preparation influenced markedly the fracture strength of this material. The calculation and measurement of the stress at the tip of an inclined elliptical notch were continued. The previously calculated orientation relation between primary and secondary cracks as a function of the tilt angle was confirmed experimentally. R.T.K.

N64-26452* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
EXPERIMENTAL DETERMINATION OF THE DEPENDENCE OF CRACK EXTENSION FORCE ON CRACK LENGTH FOR A SINGLE-EDGE-NOTCH TENSION SPECIMEN
John E. Srawley, Melvin H. Jones, and Bernard Gross Washington, NASA, Aug. 1964 20 p refs
(NASA-TN-D-2396) OTS: $0.50

The single-edge-notch form of a plane-strain (or opening mode) crack toughness specimen is particularly economical in regard to available test material and testing machine capacity. The necessary calibration relation for a particular design of a single-edge-notch specimen, centrally loaded in tension, was determined from a series of compliance measurements at crack lengths ranging from zero to one-half the specimen width. The accuracy of the calibration is estimated to be ±1/2% in the range of interest. Agreement

with concurrent results obtained by boundary collocation of an appropriate stress function is excellent. Alternative types of specimen are discussed, and the relation between necessary specimen size and the ratio of toughness to yield strength is emphasized. Author

N64-26486 Los Alamos Scientific Lab., N. Mex.
THE EFFECT OF LATERAL INERTIA ON THE PROPAGATION OF PLASTIC STRAIN IN A CYLINDRICAL ROD
G. P. DeVault 17 Jul. 1964 39 p refs
(Contract W-7405-ENG-36)
(LAMS-3081) OTS: $1.00

It is reasonable to expect that, under rapid dynamic loading, lateral inertia effects would play a significant role in the propagation of an elastic–plastic pulse along a bar. The one-dimensional approximate equations of elasticity are modified to include the effect of lateral inertia. These equations are solved analytically for step function loading. The equations are then differenced, and the stability of the resulting difference equations is discussed. Numerical solutions of the difference equations are compared with the analytic solutions. The equations are then modified to allow for plastic deformation and hysteresis in addition to the lateral inertia effect, and are solved numerically. These solutions are compared with the results of strain-rate dependent and strain-rate independent theories. It is concluded that some observations set forth as proof of the existence of a strain-rate effect might equally be explained at least qualitatively, on the basis of a lateral inertia effect. Author

N64-26530 Lincoln Lab., Mass. Inst. of Tech., Lexington
DISTORTIONS AND STRESSES OF PARABOLOIDAL SURFACE STRUCTURES Group Report 71G-1, Part IV
J. W. Mar and F. Y. M. Wan 29 Apr. 1964 161 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-55; AD-600125) OTS: $12.00

The present report is the fourth part of a series bearing the general title of "Distortions and Stresses of Paraboloidal Surface Structures." Asymptotic integration methods are used to obtain solutions for shells that are deeper than those treated in Part III. A large number of specific configurations were analyzed and the numerical results are presented in the form of dimensionless plots. The discussion is focused on the deformation behavior under gravity loads as it is affected by the span of the shell, the direction of the gravity vector, and the boundary conditions. There are also contour plots of deflections relative to the face-up position that depict the change in the shapes of the paraboloidal surface as the direction of the gravity vector is changed. Author

N64-26536 National Aeronautical Lab., Bangalore (India)
VIBRATION STUDIES ON THE NAL COMPRESSOR FOUNDATION STRUCTURE
M. L. R. Murthy, B. R. Somashekar, B. S. Dasannacharya, J. R. Cole, and Y. V. G. Acharya Dec. 1963 68 p refs
(NAL-TN-AE-22-63)

The results of model studies and theoretical analysis of the natural frequencies of vibration of a compressor foundation structure are presented. The design of machine foundations in general and of foundations for rotating machines in particular was studied, and methods and materials used for isolating the surrounding area from the residual vibrations are discussed. The natural frequencies of the foundation structure designed for the compressors are far removed from the operating frequencies of the machine components it supports, and there is no likelihood of any resonance. Author

N64-26547 Aeronautical Research Council (Gt. Brit.)
THE BUCKLING STRENGTH OF A UNIFORM CIRCULAR CYLINDER LOADED IN AXIAL COMPRESSION
A. J. Sobey London, HMSO, 1964 23 p refs
(ARC-R&M-3366; supersedes RAE-STRUCT-279; ARC-24503)

The theoretical estimation of the buckling strength of a cylinder loaded in axial compression is improved by using a more representative deflected form for the buckled cylinder than previously used. Kempner's buckling strength for dead-weight loading is reduced by 18%. The presentation of the magnitude and distribution of the constraint system required to maintain the mode are novel and instructive. Author

N64-26552 Tokyo U. (Japan) Institute of Industrial Science
THEORY AND APPLICATIONS OF SHALLOW SPHERICAL SHELLS
Yoshikatsu Tsuboi Mar. 1964 46 p *Its* Serial No. 95, vol. 14, no. 1 in JAPANESE; ENGLISH Summary

General solutions for elastic shallow spherical thin shells without surface load can be expressed by means of the Kelvin function in terms of ϕ, stress function, and ω, displacement normal to the shell surface. In this paper, physical meanings of mathematic solutions are considered, and the terms giving multivalued displacements are excluded; the membrane stress and rigid body displacement terms in the antisymmetrical case of mathematic solutions are considered, and the terms giving multivalued displacements are excluded; the membrane stress and rigid body displacement terms in the antisymmetrical case ($n = 1$ when $w = w_n \cos n\theta$ and ϕ and $\phi_n \cos n\theta$), which cannot be derived from the mathematical solutions, are added. Formulas for bending, and membrane stresses and displacements are presented as complete solutions, and particular solutions for various loads and temperature distributions are tabulated. R.T.K.

N64-26648 Purdue U., Lafayette, Ind. School of Aeronautical and Engineering Sciences
CONSTITUTIVE EQUATIONS OF VISCOELASTIC SOLIDS UNDER FINITE DEFORMATION
George Lianis Dec. 1963 57 p refs Prepared for Lockheed Propulsion Co.
(Contract AF 94(611)-8539)
(A&ES-63-11; AD-439685)

Constitutive equations are discussed. Subsequently to establish a similarity between the short-time elastic response and the long-time equilibrium stress for materials with fading memory, certain approximations are proposed. A number of boundary-value problems under prescribed static finite strain and small dynamic strains superposed on prestressed solids are solved. Existing experimental data compared with these solutions appear to favor the proposed approximations. Author

N64-26752 Aerodynamische Versuchsanstalt, Göttingen (W. Germany)
THEORY AND METHOD FOR THE CALCULATION OF AIRCRAFT FLUTTER BY USE OF THE STATIC VIBRATION TEST [THEORIE UND METHODE DER FLATTERRECHNUNG VON FLUGZEUGEN UNTER BENUTZUNG DES STANDSCHWINGUNGSVERSUCHS]
H. G. Küssner and H. Göllnitz [1964] 81 p refs In GERMAN
(AVA-64-01)

The theory of aircraft flutter is reviewed. The equilibrium equations for the concentration of force and the Rayleigh–Ritz equations for vibrating aircraft were derived. The electromechanical parameter of the aircraft was determined by

a static vibration test; the test methods are described. The aerodynamic bases of the unstationary lifting-surface theory, the approximate solutions for large and small wingspans, as well as the Kolben theory are described. The complex eigenvalue problems were solved by extending the iterative method of R. V. Mises to complex matrices. Examples of vibration calculation for a two-engine transport aircraft are discussed. Trans. by I.v.L.

N64-26779* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A SPRING-MASS REPRESENTATION OF A FREE-FREE NONUNIFORM BAR IN RESPONSE TO LONGITUDINAL FORCES
Harold P. Frisch Washington, NASA, Aug. 1964 35 p refs (NASA-TN-D-2416) OTS: $1.00

A method is presented for solving the problem of the longitudinal response of a free-free nonuniform bar to an arbitrary force applied at one end, based upon a spring-mass model of the bar. The equations obtained are solved for the case of a uniform bar with a particular set of applied forces, and the results are compared with the exact solutions of the corresponding boundary-value problem. The comparisons indicate that only a few mass points need be used in the spring-mass model to describe the displacements and that a considerable number must be used to describe the forces accurately. Furthermore, it is indicated that the local accelerations are not readily obtainable by this method. Author

N64-26809 Stanford U., Calif.
THE TRANSVERSE VIBRATIONS OF A SPINNING ANNULAR ELASTIC MEMBRANE WITH FREE EDGES
Walter Eversman Apr. 1964 104 p refs
(Grant DA-ORD-D-31-124-G238)
(SUDAER-184; AROD-2951-8; AD-443196)

The free transverse vibrations of an annular, spinning, elastic membrane with free edges were investigated. It is assumed that the vibrations of the membrane are small perturbations about the equilibrium configurations that the membrane assumes under pure rotation. The partial differential equation of the Sturm–Liouville type, which governs the vibrations, is treated by the separation of variables technique. In the case of axisymmetric vibrations, the differential equation for the radial dependence of the mode shapes is hypergeometric and is treated by established methods. The solution to Heun's equation is assumed in the form of a power-series expansion, the coefficients of which are found to satisfy a three-term recursion relation. By treating the recursion as a linear difference equation of the Poincaré type, it is shown that solutions that are finite at both edges of the membrane are possible. A numerical procedure is developed to solve the eigenvalue equation and to generate explicit solutions to Heun's equation that satisfy the free-edge conditions. Methods for computing the natural frequencies and mode shapes are presented, and computational results are included. R.T.K.

N64-26819 Stanford U., Calif.
THE RESPONSE OF VARIOUS ELASTIC AND INELASTIC BODIES TO DYNAMIC LOADINGS Final Report
Max Anliker and Chi-Chang Chao 8 Jul. 1964 13 p
(Grants DA-ARO(D)31-124-61-G54; DA-ARO(D)31-124-G238)
(AROD-2951-9; AD-443057)

Research effort in the following areas is summarized: (1) dynamic response of viscoelastic media; (2) wave propagation in a fluid-filled porous solid; (3) dynamic response of an elastic plate; and (4) free vibrations of twisted elastic bars and spinning membranes. R.T.K.

N64-26857 General Dynamics, Groton, Conn. Electric Boat Div.
SHELL MODE COUPLING Final Report
R. J. Mc Grattan, E. L. North, and C. P. Tsokos Dec. 1963 61 p refs
(Contract Nonr-3594(00))
(U411-63-041; AD-600958)

The dynamic behavior of a symmetrically stiffened cylinder was analytically and experimentally studied to determine the effects of a longitudinal steady state driving force on the radial velocity of the shell. This study showed that lobar modes are excited by a longitudinal excitation and compare well with the theoretical predictions. Also, four cases of unsymmetrically stiffened cylinders were analytically studied by the lumped mass technique to determine the effects of deep frames. The fundamental frequency is reduced as much as 20% by the added deep frames' stiffness and mass, and all of the mode shapes are irregular due to the influence of the frames. Author

N64-26873 Aerojet-General Corp., Azusa, Calif. Structural Materials Div.
INVESTIGATION OF STRESS CORRORION CRACKING OF HIGH STRENGTH STEELS Informal Monthly Report, May 1964
F. J. Darms 2 Jul. 1964 6 p
(Contract DA-04-495-ORD-3069)
(LO414-02-8; AD-602023)

The current program status includes these: (1) Four different heats of 18% nickel maraging steel were evaluated to study the effect of compositional variation on stress–corrosion susceptibility in test environments of aerated distilled water, aereated 3% NaCl solution, and a high-humidity atmosphere (140° F water-saturated air). Results indicate that susceptibility of the steel increases with strength level, which is largely determined by the titanium content. A 3% salt-water solution was a less severe medium that distilled water in causing stress-corrosion failure. (2) Environmental temperature (120° to 160° F) was found to markedly increase the stress–corrosion susceptibility of the steel, in a controlled distilled-water environment, with the-time-to-failure decreased by one-half with an 18° F increase in temperature. (3) The effect of applied tensile stress on the crack-tip corrosion potential of a center-notched, precracked tensile specimen of 18% maraging steel was measured. This potential was found to shift toward the anodic by 0.0175 mv for every 1,000 psi of net stress applied. (4) It was found that, by applying the proper amount of cathodic current, stress–corrosion cracking in a U-band specimen exposed to a 3% NaCl solution could be prevented. I.v.L.

N64-26904 Minnesota U., Minneapolis.
EFFECT OF STRESS VARIATION ON CREEP OF A SUPER ALLOY AT ELEVATED TEMPERATURES Technical Documentary Report, 1 Apr. 1963–30 Apr. 1964
Ryoichi Koterazawa Wright-Patterson AFB, Ohio, AF Materials Lab., Jun. 1964 73 p refs
(Contract AF 33(657)-7453)
(ML-TDR-64-186; AD-603058)

An investigation was conducted to evaluate the effect of cyclic stress on the creep of a super alloy at elevated temperature. Special attention was given to the frequency effect, and

experiments were carried out for a wide range of frequencies, from one cycle per day to 300 cycles per minute, where test data are lacking. Results of experiments showed that there is a relatively narrow transient range of frequencies where the effect of frequency is large, and that this transient range shifts quite regularly with the change of stress and temperature. A shift to a higher frequency is caused by higher stress level, lower stress ratio or higher temperature. As expected, the strengthening of material by cyclic stress was an important controlling factor of this phenomenon. However, another factor, recovery effect, was more significant. Some deteriorating of the material was observed in the case where the rest period is much larger than the loading period. Also, cycle dependent fatigue damage was observed in the case of high alternating stress at high frequency. Author

N64-26912 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
CONTINUED OBSERVATIONS ON THE DISTRIBUTION OF STRESS IN THE VICINITY OF A CRACK IN THE CENTER OF A PLATE Supplement to DMIC Memorandum 178
L. R. Jackson 14 Apr. 1964 50 p refs
(Contract AF 33(615)-1121)
(DMIC-MEMO-190; DMIC-MEMO-178; AD-602288)

Neuber's stress equations are rewritten entirely in rectangular coordinates. In addition, numerical results were extended to include the stress distribution around an indefinitely sharp crack. The stress function used in a British work for an indefinitely sharp crack yielded identical numerical results, even though the stress function was of a different type than that employed by Neuber. The Von Mises relation was chosen to delineate the area around a crack in which plastic flow is occurring. The numerical tables in this paper give values for the function of plane stress as well as one possible interpretation of plane strain. Values of the hydrostatic stress variant are also given for both plane stress and plane strain. Author

N64-26934 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ANALYSIS OF CREEP IN ORTHOTROPIC FIBERGLASS
M. A. Koltunov and V. N. Bezukhov 18 Jun. 1964 12 p refs
Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. I: Mat. i Mekhna. (Moscow), no. 6, 1963 p 64–70
(FTD-TT-372/1+2+4; AD-602334)

An analysis was conducted of creep in orthotropic fiberglass samples—a polyester and a glass cloth with a serge interweave. The loading of the sample was carried out at a rate of 40 kg/min. Under the effect of a prescribed load, the sample underwent an initial deformation that was read, by a spiral microscope, from the scale of a deformations transmitter. This transmitter was connected to an automatic system that regulated the loading of the sample. The precision of this control system made it possible to maintain a constant absolute deformation, within the limits $\pm 0.3\mu$ on the working base of the sample, which corresponds to an impulse of a 0.5- to 1-kg load drop. The time variation of the stresses was recorded on a "stress-time" diagram. Stress relaxation curves were obtained for the two types of fiberglass. I.v.L.

N64-26942 Army Materials Research Agency, Watertown, Mass. Materials Engineering Lab.
BUCKLING OF TORISPHERICAL SHELLS UNDER INTERNAL PRESSURE
Jiro Adachi and Miloslav Benicek Mar. 1964 20 p refs
(AMRA-TR-64-10; AD-601951) OTS: $0.50

Buckling experiments were performed on a series of model torispherical bulkheads loaded by internal fluid pressure. Models were rigid polyvinyl-chloride with a base diameter of 10.5 in. Parameters examined included thickness, central angle, and toroidal radius. Initial data obtained show the critical buckling pressure to vary exponentially with thickness and almost linearly with central angle. The buckling pressure was also very sensitive to change in toroidal radius. The use of rigid polyvinyl-chloride as a model material permitted economical fabrication of test bulkheads with very uniform thickness and uniform material properties throughout. Author

N64-26947 California Inst. of Tech., Pasadena
THE MECHANICAL AND OPTICAL CHARACTERIZATION OF HYSOL 8705 WITH APPLICATION TO PHOTOVISCOELASTIC ANALYSIS
R. J. Arenz, C. W. Ferguson, T. Kunio, and M. L. Williams Kirtland AFB, N. Mex., Res. and Technol. Div., Jun. 1964 131 p refs
(Contract AF 29(601)-5367)
(WL-TDR-64-4; AD-601878)

The main requirement for practical photoviscoelastic analysis is optical and mechanical characterization of the material. The report describes the interrelation between the stress and strain optic (operational) coefficients and approximate techniques for obtaining satisfactory quantitative results using broadband rather than three- or four-element representation of material properties. The analysis technique is accomplished by material characterization through a Dirichlet, or Prony, series representation of the time-dependent properties, and appropriate operations on their Laplace transforms. Time-dependent characteristics of a typical low modulus polymer material, Hysol 8705, are determined from constant strain rate tests for a full range of dynamic loading rates by taking advantage of the time–temperature shift phenomenon. The theory of linear viscoelasticity is then used to construct master curve representations for all pertinent properties of Hysol 8705. A one-dimensional photoviscoelastic experimental program was conducted to generate experimental data for comparison to a corresponding theoretical problem. A comparison is made between the analytically predicted fringe patterns and the experimental results; also, available two-dimensional considerations are examined. The results indicate the feasibility of quantitative photoviscoelasticity with engineering accuracy. Author

34 STRUCTURAL DESIGN

Includes structural elements; and weight analysis. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 33 Stresses and Loads.

N64-25868 Electro-Optical Systems, Inc., Pasadena, Calif.
STUDY, DESIGN, AND FABRICATION OF SOLAR ENERGY CONCENTRATOR MODELS Technical Documentary Report, 1 Jun. 1961–30 Apr. 1963
L. M. Springer Wright-Patterson AFB, Ohio, Res. and Technol. Div., Apr. 1964 128 p
(Contract AF 33(616)-8402)
(RTD-TDR-63-4051; AD-439838)

Six nonreflective, all-metal monocoque segment electroformed petals of a 44 1/2-ft-diam parabolic reflector were designed, fabricated, and tested. The interrelationships between weight, accuracy, and some structural characteristics were relatively inexpensively investigated. Fabrication techniques and process parameters were identified and evaluated for future use. Replication accuracy was related to concentrator system performance by means of a solar ray-tracing technique. Simple structural comparisons were made by means of bending and torsional spring rate determinations. Petal fabrication and test gear, including all of the required patterns and attendant electroforming equipment, were designed and fabricated.

Author

N64-25913* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

BUCKLING OF THE ECHO-A-12 PASSIVE COMMUNICATIONS SATELLITE

Wilber B. Fichter, Harvey G. Mc Comb, Jr., and Robert W. Leonard Washington, NASA, Jul. 1964 39 p refs

(NASA-TN-D-2353) OTS: $1.00

Experimental and theoretical studies have been conducted to obtain an estimate of the buckling strength of the Echo A-12 passive communications satellite. Results of experimental investigations of buckling of complete spherical shell specimens having very high radius-thickness ratios extend considerably the scope of existing experimental information. Experimental results are extrapolated by means of the classical linear theory to obtain estimates of the buckling strength of the full-scale satellite. Author

N64-25977 Atomics International, Canoga Park, Calif.

SNAP 10A STRUCTURAL ANALYSIS

J. R. Boulanger 15 Jul. 1964 59 p refs

(Contract AT(11-1)-GEN-8)

(NAA-SR-9655) OTS: $2.00

This report discusses and summarizes all stress analyses done on the SNAP 10A system; it also mentions many of the structural tests that were accomplished. A stress analysis was made on all elements of the primary structure and on all structural components. Author

N64-26293 Mare Island Naval Shipyard, Vallejo, Calif. Rubber Lab.

SUITABILITY OF MIL-P-23653 MATERIAL FOR DAMPING MECHANICAL VIBRATIONS IN LIGHT STEEL PLATING

R. R. James 12 May 1964 57 p refs

(Rept.-94-52; AD-439491)

The suitability of the damping material as described in Specification MIL-P-23653 for application to light steel plates in ballast tanks and superstructure areas of submarines was investigated. Damping efficiency of both constrained and unconstrained treatments on 3/8-in.-thick plates over the frequency range of 50 to 1,500 cps in very good with best average damping being obtained at 55° and 75° F. The tiles of damping material must be constrained to prevent possible detachment by mechanical shock. The studs on which the constrained treatment is secured should be 3/8-in. diam minimum, and the studs should be so spaced that at least one stud will be located in each tile. The damping treatment should be bonded to the steel plate but not to the constraining layer. Chemlok 301, a two-part epoxy adhesive, was a suitable bonding agent. The interface between the constraining layer and the damping material must be lubricated for best damping efficiency; petrolatum was a satisfactory lubricant. The damping material must have low permanent compressibility under deep submergence pressures to prevent loosening of constraining layers in service. New specification requirements and new specification limits that reflect service needs are proposed. Author

N64-26304 Grumman Aircraft Engineering Corp., Bethpage, N.Y. Structures Section

COMPARISON OF MATRIX METHODS FOR INELASTIC STRUCTURAL ANALYSIS

T. J. Mentel Feb. 1964 71 p refs

(ADR-02-11-64-1)

A number of recently proposed schemes for applying standard matrix structural analysis to problems involving plasticity and creep are examined and illustrated using a simple truss problem. Certain limitations of these methods are pointed out and explained with special emphasis on convergence of the computer procedure. Some new methods, derived from the current schemes, are also studied. No single method appears to emerge superior to all others, for the uniaxial stress problem. Recommendations are given concerning the use of the methods. Author

N64-26519 Atomics International, Canoga Park, Calif.

SNAP 2 STRUCTURAL AND DYNAMIC ANALYSIS

R. A. Castle 1 May 1964 127 p refs

(Contract AT(11-1)-GEN-8)

(NAA-SR-9054) OTS: $2.50

The structural design criteria and the system basic loads for the SNAP 2 compact power unit are presented. Included in these structural criteria are the following environments—ground, prelaunch, launch, preorbital startup, and orbital startup and continuous operation. These data were then used to determine the structural integrity of the system and to satisfy the reliability requirements. A summary is presented of the more significant system structural and dynamic analyses generated on the SNAP 2 compact power unit. Author

N64-26577* General Electric Co., Philadelphia, Pa. Space Sciences Lab.

STUDY OF THE RELATIONSHIP OF PROPERTIES OF COMPOSITE MATERIALS TO PROPERTIES OF THEIR CONSTITUENTS Quarterly Progress Report

Norris F. Dow, Zvi Hashin (Pennsylvania U.), and Walter Rosen 24 Jul. 1963 49 p refs

(Contract NASw-817)

(NASA-CR-58182; QPR-3) OTS: $4.60 ph

This is a study of the influence of constituent properties upon composite performance. Parametric studies of the influence of geometry and properties of fiber and matrix upon the structural efficiency of cylindrical sandwich shells in axial compression are presented. Analytical and experimental studies of elastic constants and tensile strength of modified matrix materials are also included. Author

N64-26611 Bettis Atomic Power Lab., Pittsburgh, Pa.

STRUCTURE DESIGN NOTES: CALCULATION OF STRESSES, FORCES, AND DEFLECTIONS IN LINEAR-ELASTIC SKELETON STRUCTURES WITH TEMPERATURE, PRESSURES, APPLIED LOADS AND REDUNDANT LOADS

C. M. Friedrich Apr. 1964 99 p refs

(Contract AD(11-1)-GEN-14)

(WAPD-TM-417)

Matrix theory was successfully used for subassembly stresses, shock and vibration responses, thick shells of revolution, and other problems for linear elastic structures. A new program, MO397, was written with simplified matrix input to help the engineer solve structure problems. Sample problems are discussed to explain the theory and to show how to determine the effects of thermal distortions and mechanical clearances. Author

N64-26830 Army Missile Command, Huntsville, Ala.

THE RELIEF TRANSITION. THE MOST FAVORABLE SHAPES FOR THE TRANSITIONS ON SHOULDERED SHAFTS, ETC.

A. Thum and W. Bautz 13 Jul. 1964 14 p refs Transl. into ENGLISH from Forsch. Gebiete Ingenieurw. (Germany), v. 6, no. 6, 1935 p 269–273

(RSIC-212; AD-443435)

The transition from thicker to thinner cross sections is an indispensable structural element, both for machine design and for building construction. Circular transition, relief transition at tensile stress, relief transition at bending, and torsional stress are discussed. Information is given on a transition form for the joining of cross sections of different sizes. Experimental results indicate that it is advisable to replace the circular arc transition, wherever possible, by the relief transition. R.T.K.

N64-26877 Joint Publications Research Service, Washington, D.C.

CALCULATING THE STRENGTH OF SCREW PROPELLER BLADES FOR SHIPS USED IN ICE NAVIGATION

M. A. Ignat'yev 14 Aug. 1964 13 p ref Transl. into ENGLISH from Problemy Arktiki i Antarktiki (Leningrad), no. 16, 1964 p 75–82

(JPRS-25936; TT-64-41207) OTS: $1.00

A method for calculating the structural dimensions of the blades of screw propellers of vessels used in ice navigation is developed on the basis of theoretical and experimental investigations. The formulas obtained can be used in calculating the strength of the blades. I.v.L.

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